



Coastal Protection and  
Restoration Authority of Louisiana

**State of Louisiana**

**Coastal Protection and Restoration  
Authority of Louisiana (CPRA)**

## **2012 Operations, Maintenance, and Monitoring Report**

for

### **FRESHWATER INTRODUCTION SOUTH OF HIGHWAY 82**

State Project Number ME-16  
Priority Project List 9

June 2012  
Calcasieu Parish

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For  
Freshwater Introduction South of Highway 82 (ME-16)

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## Preface

This report includes monitoring data collected through December 2011, and annual Maintenance Inspections through May 2012.

The 2012 report is the 2<sup>nd</sup> report in a series of reports. For additional information on lessons learned, recommendations and project effectiveness please refer to the 2008 Operations, Maintenance, and Monitoring Report on the LDNR web site ([http://sonris-www.dnr.state.la.us/sundown/cart\\_prod/cart\\_bms\\_avail\\_documents\\_f](http://sonris-www.dnr.state.la.us/sundown/cart_prod/cart_bms_avail_documents_f)).

## I. Introduction

The Freshwater Introduction South of LA Hwy 82 project was proposed on the 9<sup>th</sup> priority list of the Coastal Wetlands Planning, Protection, and Restoration Act (CWPPRA). The project area is located in the central and eastern portions of Rockefeller State Wildlife Refuge, and Miami Corporation on the eastern end of the Grand Chenier ridge, approximately 10 miles (16.09 km) east of the community of Grand Chenier in Cameron and Vermilion Parishes, La (figure 1). It is bounded to the west by a canal west of Little Constance Bayou south of Deep Lake, to the south by the Gulf shoreline of the unmanaged marsh south of Unit 6, to the east by Rollover Bayou to a line from Flat Lake to the western boundary of Unit 15 and to the north by Louisiana LA Hwy 82. The project will benefit some 19,988 acres (8,088.87 ha) of which 15,835 acres (6,408.21 ha) are marsh and the remaining 4,153 acres (1,680.66 ha) are open water (USGS 1999).

The “Lakes” subbasin of the Mermentau Basin is experiencing high water levels (>2 ft MLG) due to the existence of locks and gates that control water levels and prevent saltwater intrusion into Grand and White Lakes. The “Chenier” subbasin of the Mermentau Basin is experiencing saltwater intrusion due to lack of freshwater flow caused by the presence of the hydrologic barriers consisting of LA Hwy 82 and the Lakes subbasin gates and locks. Marsh loss is occurring in the Chenier subbasin due to saltwater intrusion and in the Lakes subbasin due to high freshwater water levels which stress *Spartina patens* (marshhay cordgrass) and certain fresh marsh species and cause increased shoreline erosion along White Lake and Grand Lake (Clark 1999).

Most of the soils in the project area are classified as either Clovelly muck, Scatlake mucky clay or Bancker muck, which are level, poorly drained fluid soils (U.S. Department of Agriculture [USDA] 1995). Clovelly muck and Bancker muck are organic and mineral soils respectively, found in brackish marsh, whereas Scatlake mucky clay, prevalent at the southern end of the project area, is a mineral soil found in saline marshes.

The habitats in the project and adjacent areas are brackish and intermediate emergent marsh with saline marsh along the edge of the Gulf of Mexico (Chabreck et al., 1968, Chabreck and Linscombe, 1978, 1988). Dominant emergent vegetation species present in and adjacent to the project include *Spartina patens* (marshhay cordgrass), *Schoenoplectus americanus* (chairmaker’s bullrush), *Distichlis spicata* (inland saltgrass), *Phragmites australis* (Roseau cane) and *Schoenoplectus robustus* (leafy three-square) (USDA-NRCS 2002).

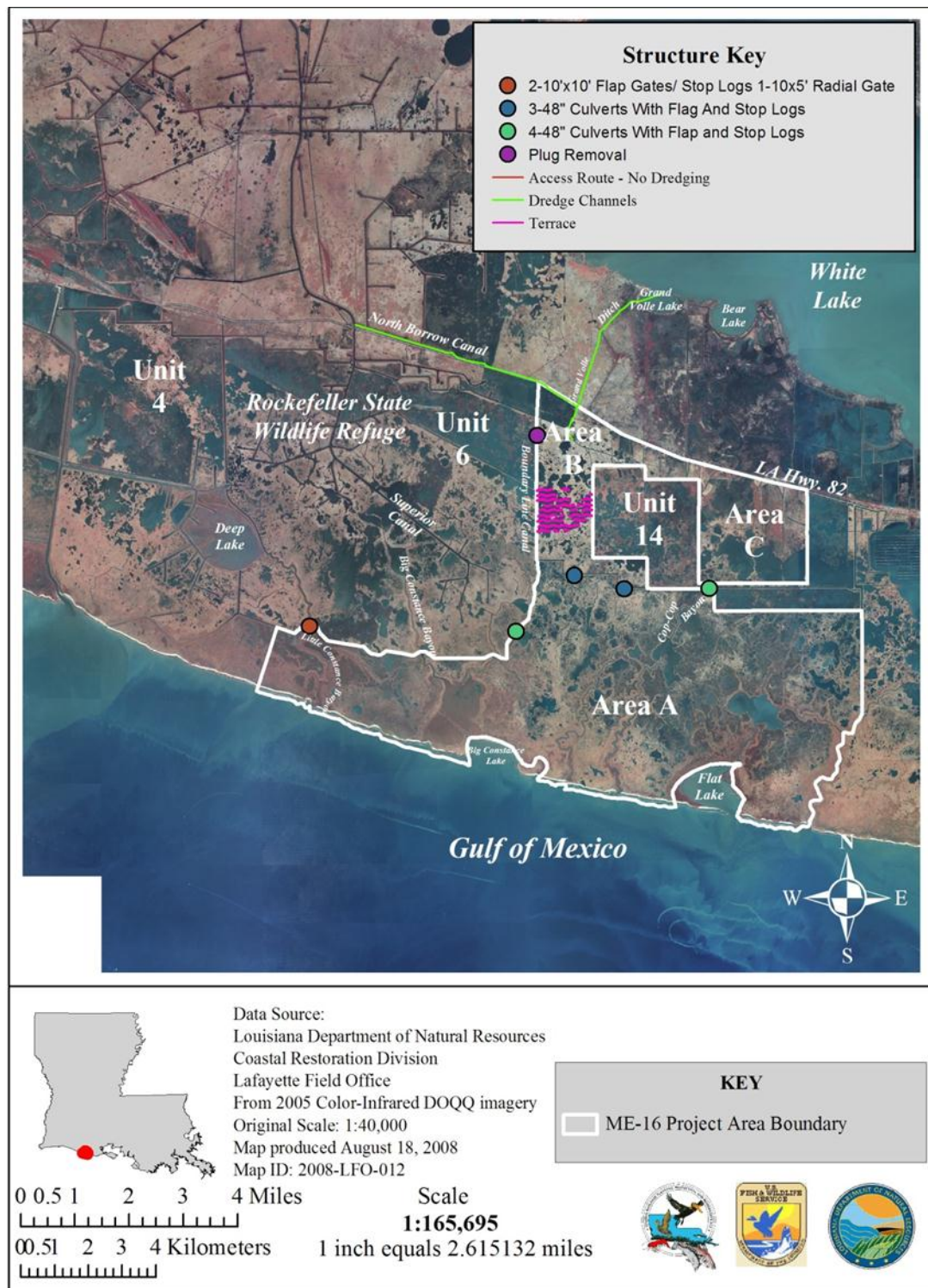
The project is co-sponsored by the United States Fish and Wildlife Service (USFWS) and the Coastal Protection and Restoration Authority of Louisiana (CPRA) and is designed to move water from Grand and White Lakes (when adequate head differential exists) to marsh areas south of LA Hwy 82, in order to moderate elevated salinities in Areas A, B and C. In addition 14 acres (5.67 ha) of marsh will be created through the construction of terraces in Area B (figure 1).

A model was prepared by Fenstermaker and Associates and a report was submitted to evaluate the effects of the project (C.H. Fenstermaker and Associates [CHFA] 2003). The modeling software used was MIKE 11, a one-dimensional model used for simulating flows, sediment transport, and water quality in estuaries, rivers, irrigation systems, and similar water bodies. The model showed that, overall, the project would reduce salinities in Area A. The magnitude of salinity reduction varied from each location with variances from 1-2 ppt to 3-4 ppt. The flap gates of the proposed structures at Little Constance Bayou, Dyson Bayou, Cop Cop Bayou, and structures No. 10 and 12 in the Boundary Line Levee should protect Unit 6 and Areas B and C from salinity spikes.

The construction phase of the project consisted of the following components:

1. The borrow canal along Hwy 82 and the trenasse connecting Superior Canal to the borrow canal was widened and deepened.
2. The Grand Volle Ditch was widened and deepened on both sides of Hwy 82 and a conveyance channel was constructed into Grand Volle Lake from Grand Volle Ditch. A barricade was also placed at the intersection of Grand Volle Ditch and Grand Volle Lake
3. Approximately 26,000 linear ft of vegetated “duck-wing” terraces were constructed in the shallow open water between Units 6 and 14.
4. The plug in the Superior Canal branch that forms the eastern boundary of Rockefeller Refuge Unit 13 at the NE portion of Unit 13/Unit 6 Boundary line canal was removed.
5. The existing Little Constance Bayou water control structure was replaced with 4 – 4’-8” X 6’-8” flap gates on the south side and stop logs on the north side.
6. A new structure with four 48 in diameter culverts with flapgates and stoplogs was installed north of the existing Dyson Bayou structure near the NW portion of a small lake in the Unit 6 Boundary Line levee.
7. A new structure with four 48 in diameter culverts with flapgates and stoplogs was installed near the plugged Cop Cop Bayou adjacent to the existing Cop Cop Bayou structure.
8. Two new structures (10 and 12) with three 48 in diameter culverts with flapgates and stoplogs were installed in the Boundary Line Levee south of Unit 14.
9. The existing boundary line channel near the Cameron-Vermilion Parish line was widened and deepened.

Construction of the project features was completed in October 2006.



**Figure 1.** Freshwater Introduction South of Hwy 82 (ME-16) project area and construction features.



## **II. Maintenance Activity**

### **a. Project Feature Inspection Procedures**

The purpose of the annual inspection of the Freshwater Introduction South of Highway 82 Project (ME-16) is to evaluate the constructed project features to identify any deficiencies and prepare a report detailing the condition of project features and recommended corrective actions needed. Should it be determined that corrective actions are needed, CPRA shall provide, in the report, a detailed cost estimate for engineering, design, supervision, inspection, and construction contingencies, and an assessment of the urgency of such repairs. The annual inspection report also contains a summary of maintenance projects which were completed since completion of constructed project features and an estimated projected budget for the upcoming three (3) years for operation, maintenance and rehabilitation. The three (3) year projected operation and maintenance budget is shown in Appendix B.

An inspection of the Freshwater Introduction South of Hwy 82 Project (ME-16) was held on two consecutive days. Inspection of the terraces took place on October 26, 2011 and inspection of the structures took place on October 27, 2011 under clear skies and cool temperatures. In attendance on October 26 were Dion Broussard, Mark Mouledous, Tim Harper, and Catherine Ricks of CPRA. In attendance on October 27 were Dion Broussard, Dewey Billodeau, Darrell Pontiff, and Mark Mouledous of CPRA, Darryl Clark of USFWS, and Tanita Baker of EJES for other inspections. All parties met at the boat launch on the northern end of Unit 14 at LA Hwy 82 both days. The annual inspection began at approximately 10:30 a.m. both days.

The field inspection included a complete visual inspection of all project features. Staff gage readings and existing temporary benchmarks where available were used to determine approximate elevations of water, earthen terraces, rock dike, and other project features. Photographs were taken at each project feature (see Appendix A) and Field Inspection notes were completed in the field to record measurements and deficiencies (see Appendix C).

### **b. Inspection Results**

#### **New Cop-Cop Structure**

The structure is in good condition. Leaks at interface of pipe and headwall discovered during the recent maintenance project have been repaired by the contractor. Rock revetment looks good. Contractor needs to provide lifting chains for lifting of flapgates. (Photos: Appendix A, Photos 1 & 2)

#### **Structure No. 12**

Overall this structure is also in good condition. Rock revetment looks good. (Photos: Appendix A, Photo 3 & 4)

### **Structure No. 10**

Overall this structure is in good condition. Rock revetment looks good. Contractor needs to move some rock closer to the structure and provide lifting chains for lifting of flapgates. (Photos: Appendix A, Photo 5 & 6)

### **Earthen Terraces**

The terrace field is in very good condition. The vegetation is healthy and there appears to be little erosion. (Photos: Appendix A, Photo 11 & 12)

### **Grand Volle South Channel Enlargement**

This area was not inspected during this field trip.

### **New Dyson Structure**

Overall this structure is in good condition. Rock revetment looks good. Contractor needs to provide lifting chains for lifting of flapgates. (Photos: Appendix A, Photo 7 & 8)

### **Little Constance Structure**

Overall this structure is in good condition. Rock revetment looks good. Contractor needs to repair section of broken concrete on structure, which occurred by rock hitting structure during maintenance event. (Photos: Appendix A, Photo 9 & 10)

### **Louisiana Highway 82 Channel Enlargement**

This area was not inspected during this field trip.

### **Grand Volle North Channel Enlargement and Marine Barrier**

This area was not inspected during this field trip.

### **Boundary Line Channel Enlargement and Earthen Plug Removal**

This area was not inspected during this field trip.

#### **c. Maintenance Recommendations**

##### **i. Immediate/ Emergency Repairs**

##### **ii. Programmatic/ Routine Repairs**

No maintenance work required at this time.



#### d. Maintenance History

**General Maintenance:** Below is a summary of completed maintenance projects and operation tasks performed since December 2006, the construction completion date of the Freshwater Introduction South of Hwy 82 Project (ME-16).

**2011 – Hurricane Ike Repairs to New Cop Cop, Structure 12, Structure 10, New Dyson, and Little Constance water control structures – B & J Marine Services –** This maintenance project included placing rock revetment at all five water control structures within the project boundary.

- New Cop Cop – approximately 94 tons of rip rap placed
- Structure 12 – approximately 377 tons of rip rap placed
- Structure 10 – approximately 159 tons of rip rap placed
- New Dyson – approximately 198 tons of rip rap placed
- Little Constance – approximately 467 tons of rip rap placed

At the time of construction, the contractor uncovered sinkholes above pipes at the New Cop Cop and New Dyson structures. The sinkholes were created by water infiltrating through breeches in the seal between the pipe and headwall. A change order was issued and the contractor repaired the breeches by excavating soil around the pipe, sealing the pipe and headwall with Wet Dry 700 and redi-mix concrete, and then backfilling.

This maintenance project was a result of damages sustained from Hurricane Ike's storm surge in September 2008.

Construction Costs	\$300,484.44
Engineering and Design, Construction Oversight	\$79,202.27
<b>Total Cost</b>	<b>\$379,686.71</b>

### III. Operation Activity

#### a. Operation Plan

Operation Plan Control Structure	Structure Type	Area Controlled	Salinity Target Level	Water Target Level	Operation
Little Constance Control Structure  Note: no change to Big Constance Structure	Existing structure modified from 3 - 10 ft wide X 8 ft deep radial arm gates to flapgates on the south side and stoplogs on the north side.	Unit 6 and Area A Unmanaged-unit	5/10 ppt @ Superior Canal-Hwy 82 Bridge	3" below marsh level (0.75 feet NAVD88)	<u>Maintenance</u> – All flapgates open and stop logs removed when target levels not exceeded. <u>Salinity Target</u> – 2 bays closed (i.e., flapgates lowered) when 5 ppt salinity target level reached, stoplogs removed; all bays closed (all 3 flapgates lowered) when 10 ppt salinity reached, stoplogs removed. <u>Water Level Target</u> – Stoplogs set at marsh level to 0.5 feet below marsh level when water levels reach target levels (3 inches BML or 0.75 ft NAVD88) or less.
Existing Dyson Bayou and Bayou Josephine WCSs	4 – 48 inch diameter culverts with flapgates on south and stop logs on north (Unit 6) side.	Unit 6 and Area A	5/10 ppt @ Superior Canal-Hwy 82 Bridge	3" below marsh level (0.75 feet NAVD88)	<u>Maintenance</u> – All gates flapping, stop logs at 2 ft below marsh level <u>Water Level Target</u> – Stop logs set at marsh level to 0.5 ft below marsh level when water levels approach target levels (0.75 ft NAVD88) @ Superior Canal.
New Dyson Bayou WCS	4 – 48 inch diameter culverts with flapgates on south and stop logs on north (Unit 6) side.	Unit 6 and Area A	5/10 ppt @ Superior Canal-Hwy 82 Bridge	3" below marsh level (0.75 feet NAVD88)	<u>Maintenance</u> – All gates flapping, stop logs at 2 ft below marsh level <u>Water Level Target</u> – Stop logs set at marsh level to 0.5 ft below marsh level (1.0 ft to 0.5 ft) when water levels approach target levels (0.75 ft NAVD88) @ Superior Canal.
Existing Cop-Cop Bayou WCS	4 – 48 inch diameter culverts with flapgates on south and stop logs on north side.	Area A and Areas B and C	6 ppt @ Area A at Unit 14 station	3" below marsh level (0.75 feet NAVD88)	<u>Maintenance</u> – All gates flapping, stop logs at 2 ft below marsh level <u>Ingress Period</u> (May-June) – Flapgates raised; Stop logs at 2 ft below marsh level or lower <u>Water Level Target</u> – Stop logs set at marsh level to 0.5 ft below marsh level (1.0 ft to 0.5 ft) when water levels approach target levels (0.75 ft NAVD88) @ Superior Canal.
New Cop-Cop Bayou, New Structures 10 and No. 12 WCS	4 – 48 inch diameter culverts with flapgates on south and stop logs on north side.	Area A and Areas B and C	6 ppt @ Area A at Unit 14 station	3" below marsh level (0.75 feet NAVD88)	<u>Maintenance (Always)</u> – All gates flapping, stop logs at 2 ft or greater below marsh level <u>Water Level Target</u> – Stop logs set at marsh level to 0.5 ft below marsh level (1.0 ft to 0.5 ft) when water levels approach target levels (0.75 ft NAVD88) @ Superior Canal.

Note: The above operational plan submitted by Darryl Clark with USFWS.

## **b. Actual Operations**

In accordance with the operation schedule outlined in the Operation and Maintenance Plan and as shown above, the structures were manipulated by Louisiana Department of Wildlife and Fisheries personnel. See the summary below of operations performed annually for the freshwater introduction structures.

- **2006** - Water control structures became operational in October, 2006. Stop-logs were set at marsh level at that time (approximately 1.0 NAVD). Stop logs were removed to -1.0 NAVD on October 23, 2006 due to a late tropical weather event that caused high tides and flooding from rainfall. Water levels rose to +2.0 NAVD in the Mermentau Basin in November and receded to +0.7 by the end of December.
- **2007** – Stop-logs in all structures remained at -1.0 NAVD throughout the year. Water levels ranged from 1.90 NAVD in January to 0.74 in November. Stop logs were replaced in December 2007 and set at +0.5 NAVD
- **2008** – Stop-logs were set at approximate marsh level (+1.0 NAVD). At the Old Cop-Cop structure, stop logs were removed between January and April. By June 2008, the structure was damaged and water control was compromised. In June 2008, stop-logs were removed from all remaining structures. After the heavy rainfall events, the stop-logs were replaced and set at +0.80 NAVD.
- **2009** – Stop-logs were removed in May 2009 and replaced in June 2009 (+0.80 NAVD). The stop-logs were again removed in October 2009.
- **2010** – Stop-logs were replaced in March 2010 and set at +0.80 NAVD.
- **2011** – Throughout the year, the stop logs were set at +0.80 NAVD due to low water levels and higher salinity.
- **2012** – In January 2012 the stop logs were removed. The stop-logs were replaced in April 2012 and set at +0.80 NAVD. The stop-logs were again removed in July 2012.

## **IV. Monitoring Activity**

CWPPRA projects authorized for construction after August 14, 2003 will be monitored only with Coastwide Reference Monitoring System-*Wetlands* (CRMS) stations and other existing data collection. At the request of the federal sponsor (USFWS) one additional continuous recorder was specifically added to the project and will be funded through project-specific monitoring funds. There are 4 CRMS-*Wetlands* sites in the project area (figure 2).

### **a. Monitoring Goals**

The objective of the Freshwater Introduction South of Hwy 82 project is to protect and restore intermediate and brackish marshes within the project area over the 20-year project life.

The following goals will contribute to the evaluation of the above objectives:

1. Reduce the rate of marsh loss in Area A saline marshes from 0.16%/yr to 0.11%/yr, in Area A brackish marshes from 0.16%/yr to 0.10%/yr, in Area B marshes from 0.24%/yr to 0%/yr and Area C marshes from 0.56%/yr to 0.39%/yr.
2. Reduce mean salinity levels in Area A saline marshes from 20 ppt to 17 ppt, in Area A brackish marshes from 15 ppt to 11 ppt, and in Areas B and C, from 5 to 4 ppt.
3. Increase the coverage of emergent wetland vegetation within Areas A, B and C.
4. Increase the coverage of submerged aquatic vegetation (SAV) in the shallow open water areas within Areas A, B and C.

### **b. Monitoring Elements**

#### **Aerial Photography:**

Aerial photography and satellite imagery is collected for the entire coast through CRMS-*Wetlands*. The satellite imagery was analyzed to determine land and water areas for the entire coast. This imagery was subset and used to qualitatively evaluate changes in land and water areas within the ME-16 project area at a coarse (25m) resolution. Photography and satellite imagery for the Mermentau Basin was collected and analyzed in 2005 and 2008, and will be collected every 3 years thereafter.

Percent land trends were calculated using Landsat Thematic Mapper (TM) data for 1985 - 2010. Linear regressions were calculated for the period of record. The variability in percent land data points around the slope illustrate the influence of various sources of environmental variance or classification error. Positive slopes indicate increasing percent land or historical land gain and negative slopes indicate decreasing percent land or historical land loss (Couvillion et al., 2011).

#### **Salinity:**

Salinity is monitored hourly utilizing 4 CRMS-*Wetlands* stations (599, 600, 609, 610) within the project area and selected reference site 615. A project-specific continuous recorder (ME16-06) was installed within Muskrat Bayou southeast of Cop-Cop Bayou to further measure project effects on salinity levels (figure 2). Salinity is measured every hour with a salinity gauge that is attached to the water-level gauge. The gauges are serviced at the same time. Continuous data will be used to characterize average annual salinities throughout the project and reference areas. At each servicing, a measurement of interstitial water salinity is collected adjacent to each gauge. Interstitial water salinity is also determined at 5 of the vegetation plots, when vegetation is surveyed. Salinity data will be used to characterize the

spatial variation in salinity throughout the project area and to determine if project area salinity is being maintained within the target range. For this report, data were available pre-construction at stations ME16-01, ME16-02, ME16-03, ME16-04R, ME16-05R, and pre- and post-construction at station ME16-06 and CRMS sites inside (599, 609) and outside (615) the project area.

Station	Data Collection Period
ME16-01	5/21/01 – 2/19/04
ME16-02	5/21/01 – 2/19/04
ME16-03	6/21/01 – 2/19/04
ME16-04R	1/9/02 – 2/19/04
ME16-05R	2/7/02 – 2/19/04
ME16-06	3/3/05 – present
CRMS0599	11/14/06 – present
CRMS0609	12/11/07 – present
CRMS0615	6/20/06 – present

#### **Water Level:**

Water level within the marsh is measured at every salinity station every hour with a water-level gauge installed within an area that is hydrologically connected to the surrounding water body. The gauge is surveyed relative to the top of the RSET (NAVD 88). The water-level gauge is serviced on approximately a monthly basis. Water level data is used to document the variability in water level in the project and reference areas.

#### **Vegetation:**

Vegetation composition and cover was estimated from 10 permanent 2x2 m plots that were randomly distributed along a transect in the emergent marsh within each of the 1 km<sup>2</sup> CRMS-Wetlands sites. Data were collected in early fall of 2006 - 2011 using the Braun Blanquet method.

Individual species' cover data were summarized according to the Floristic Quality Index (FQI) method (Cretini and Steyer 2011). A list of plants occurring in Louisiana's coastal wetlands (~500 species) was provided to all known Louisiana coastal vegetation experts and their input on scoring was requested. The panel then provided an agreed upon group score (Coefficient of Conservatism or CC score) for each species. CC scores are weighed based on cover in the FQI for Louisiana coastal wetlands. All species known to occur in the coastal zone were given a floristic quality score on a scale of 0 to 10. Species that scored the lowest were considered by the panel to indicate disturbance or unstable marsh environments. CRMS sites inside (599, 600, 609, 610) and outside (615) the project were used for this report.

#### **CRMS Supplemental**

In addition to the project specific monitoring elements listed above, a variety of other data are collected at CRMS-Wetlands stations which can be used as supporting or contextual information. Data types collected at CRMS sites include hydrologic from continuous

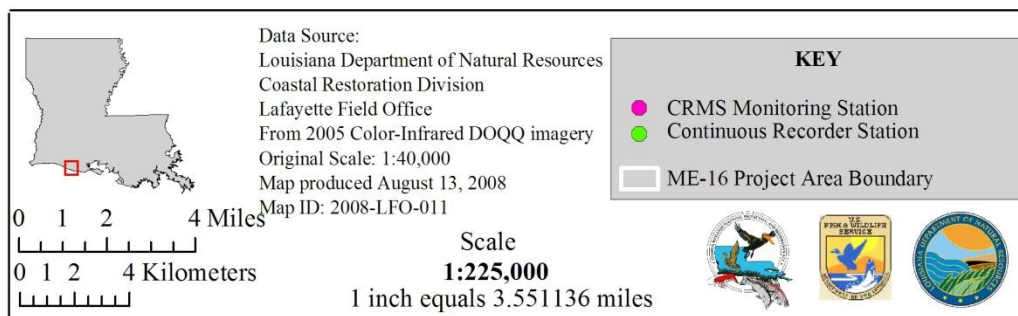
recorder (mentioned above), vegetative, physical soil characteristics, discrete porewater, surface elevation, and land:water analysis of 1 km<sup>2</sup> area encompassing the station (Folse et al., 2012). For this report, data from four sites within the project area are compared to data from four sites outside the project area in a traditional project versus reference manner. Data collected from the CRMS network are used to develop integrated data indices at different spatial scales (local, basin, coastal) from which we can assess project performance.

Soil cores were collected one time (within a year of site establishment) to describe soil properties (bulk density and percent organic matter). Three, 4" (10.16-cm) diameter cores were collected to a depth of 24 cm and divided into 6, 4-cm sections at the site. The soil was processed by the Department of Agronomy and Environmental Management at Louisiana State University.

Average annual salinity and percent time flooded are used to develop a Hydrologic Index (HI) score (Snedden and Swenson 2012) based on the suitability of the site in maximizing vegetation productivity according to its specific marsh class (swamp, fresh, intermediate, brackish, and saline). The HI score (between 0 and 100) corresponds to the percent of maximum vegetation productivity expected to occur if the separate effects of salinity and inundation interact in a multiplicative fashion on vegetation productivity.

Soil surface elevation change utilizing a combination of sediment elevation tables (RSET) and vertical accretion from feldspar horizon markers are being measured twice per year at each site. This data will be used to describe general components of elevation change and establish accretion/subsidence rates. The RSET was surveyed to a known elevation datum (ft, NAVD88) so it can be directly compared to other elevation variables such as water level. Currently, data has not been collected over enough time to calculate viable rates, therefore, elevation change is not included in this report.





**Figure 2.** Location of project-specific monitoring stations and CRMS-Wetlands stations within Freshwater Introduction South of Hwy 82 (ME-16) project area and surrounding marsh.

### c. Preliminary Monitoring Results and Discussion

#### **Aerial Photography:**

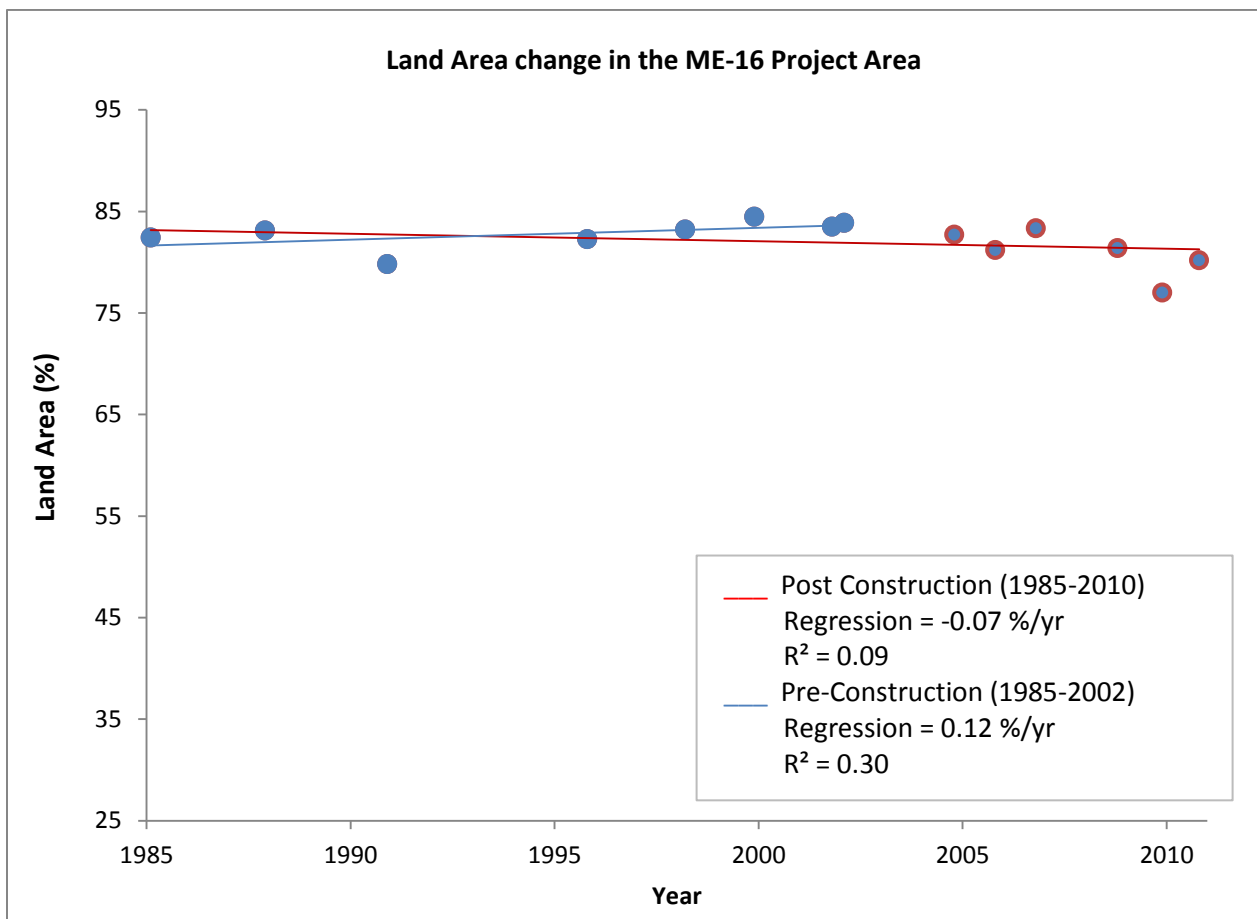
It is difficult to assess the goal of reducing the rate of marsh loss in the project area at this time due to a limited amount of data. Future analysis will help to better determine the project's effect on land change.

For the four CRMS-Wetlands stations within the project area, the 2005 and 2008 digital imagery was collected (Table 1). Mild land loss occurred at Station 600 (~8 acres) while stations 599, 609 and 610 essentially saw no change.

The general land change trend within the project area prior to construction was slightly positive (0.12% per year) from 1985 to 2005 (figure 3). Incorporating the 2005 to 2010 data, which includes the post-construction satellite imagery, causes the general trend to become slightly negative (-0.07% per year). Land loss occurred in 2005, 2008 and 2009 following Hurricanes Rita and Ike, but the project area saw a 3% gain in 2010.

**Table 1.** Land:Water acreages for 2005 and 2008 at CRMS sites in the project area.

CRMS Site		2005		2008		Change 2005 to 2008
		acres	%	acres	%	acres
599	Land	225	90.73	226	91.13	1
	Water	23	9.27	22	8.87	
	Total	248		248		
600	Land	233	93.95	225	90.73	-8
	Water	15	6.05	23	9.27	
	Total	248		248		
609	Land	180	72.58	178	71.77	-2
	Water	68	27.42	69	28.94	
	Total	248		248		
610	Land	236	95.16	237	95.56	1
	Water	12	4.84	11	4.44	
	Total	248		248		



**Figure 3.** Project scale percent land change for ME-16. Percent land values are displayed for all cloud free TM images available for 1984-2010. The red line depicts the percent land trend for the entire period of record. The blue line depicts the percent land trend for the pre-construction time period only. Percent land calculated as percent land of total project area. See Couvillion et al. 2011.

### Salinity:

Pre-construction data was collected for the model from May 2001 through February 2004 at project sites and reference sites (Table 2). ME16-01, located in the boundary line canal south of Unit 14 (Area C), was below the target range of 4 ppt for intermediate marshes 71% of the time. Project area brackish stations (ME16-02 and ME16-03), located in Area A, were below the target range of 11 ppt roughly 68 and 56% of the time, respectively. Station ME16-4R, located at the mouth of Rollover Bayou, near the Gulf of Mexico (considered saline), was under 17 ppt 81% of the time the station was active. Station ME16-05R, located in Grand Volle Lake, is considered a source of fresh water for the project area. Salinities were below the target range of 4 ppt for fresh marshes 100% of the time.

**Table 2.** Salinities during model development (May 2001 – February 2004)

Station	Area	Marsh Type	Salinity (ppt)		%Time within Target
			Target	Average	
ME16-01	C	Intermediate	4	3.37	71
ME16-02	A	Brackish	11	7.96	68
ME16-03	A	Brackish	11	10.59	56
ME16-4R	Ref	Saline	17	11.17	81
ME16-05R	Ref	Intermediate	4	0.32	100

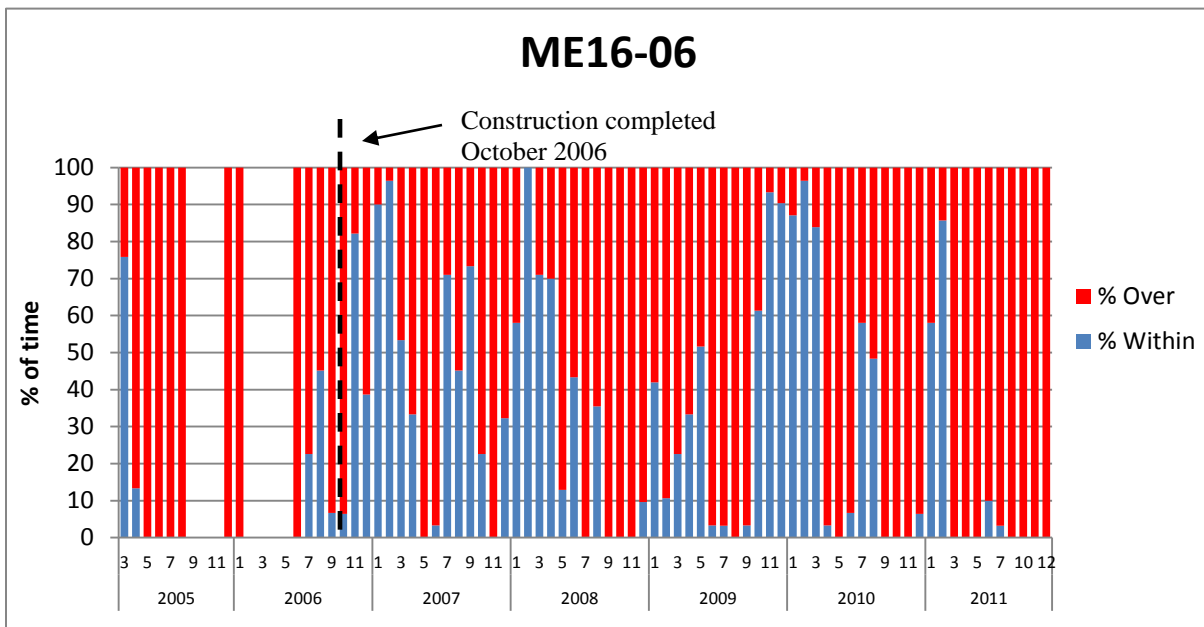
Pre- and Post-construction data were collected at sites ME16-06 and CRMS0615. Brackish project area station ME16-06 was within the target range only 14% in the year prior to construction but since construction in October 2006, salinities have been within the target range 33% of the time (figure 4a). CRMS station 615, chosen as a reference for the brackish stations, has been under the ME-16 target salinity (11 ppt) 35% of the time since the project was constructed (figure 4b).

Post-construction data was collected at sites CRMS0599 and CRMS0609. CRMS station 599, which is a saline project area station, had salinities below the 17 ppt saline target salinity 65% of the time (figure 4c). CRMS station 609, a brackish station located just southeast of water control structure No. 10 (Area A), was within the target range 41% of the time for December 2007 – December 2011 (figure 4d).

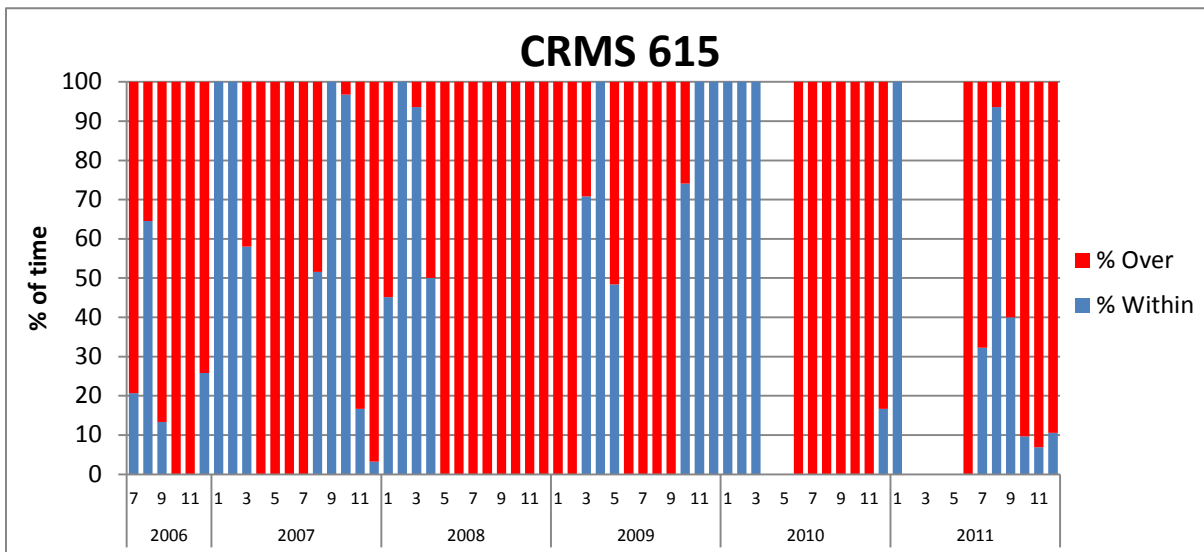
For the period 2008-2011, average weekly salinities at project station ME16-06 and CRMS0609 were compared to reference station CRMS0615 to determine if a difference in salinity occurred between the project and reference area (figure 4e). It was found that salinities within the project area were significantly lower than salinities at the reference station in all years except 2011 ( $\chi^2=26.434$ ,  $p<.0001$ ).

Therefore, the goal to reduce salinities post-construction produced mixed results. Salinity levels are reduced in the brackish marshes in the central portion of Area A during high rainfall events, but the benefits are reduced as the distance from the structure increases. ME16-06 did not show the reduced salinities that were shown at CRMS0609, just south of structure 10, particularly in drought years such as 2011. The saline marshes in the southwestern corner of Area A are meeting target salinities during the majority of the time.

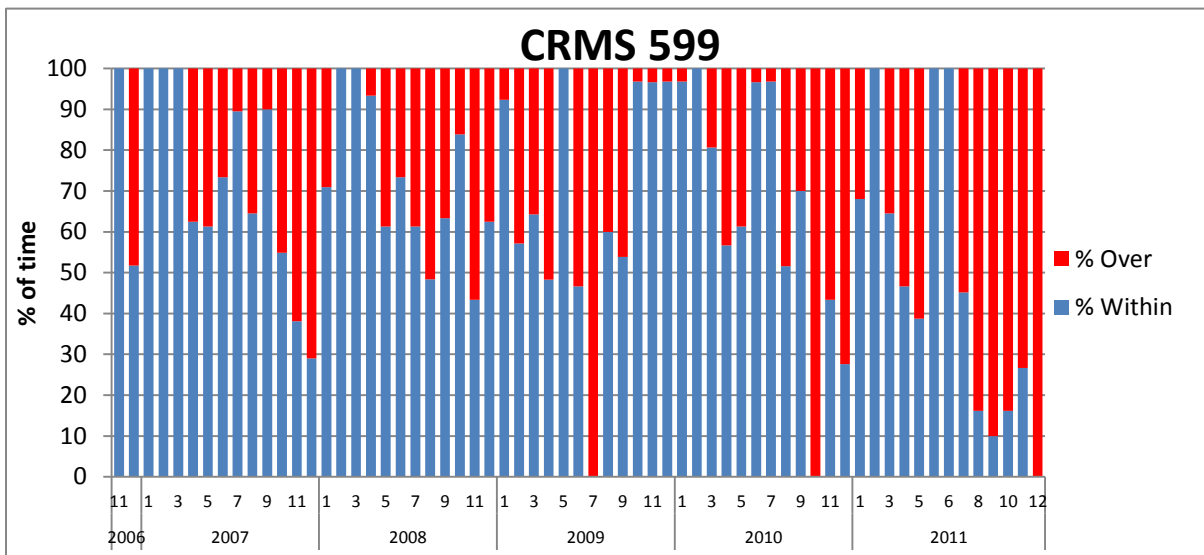
Means by month of interstitial water salinity is presented in figures 5a and 5b. The highest salinities occurred in project stations 599 and 600, averaging over 20 ppt. Project stations 609 and 610 and reference station 615 averaged around 14 ppt at the 10 cm level. For the 30 cm level, salinities for these 3 stations were slightly higher, averaging 16-18 ppt.



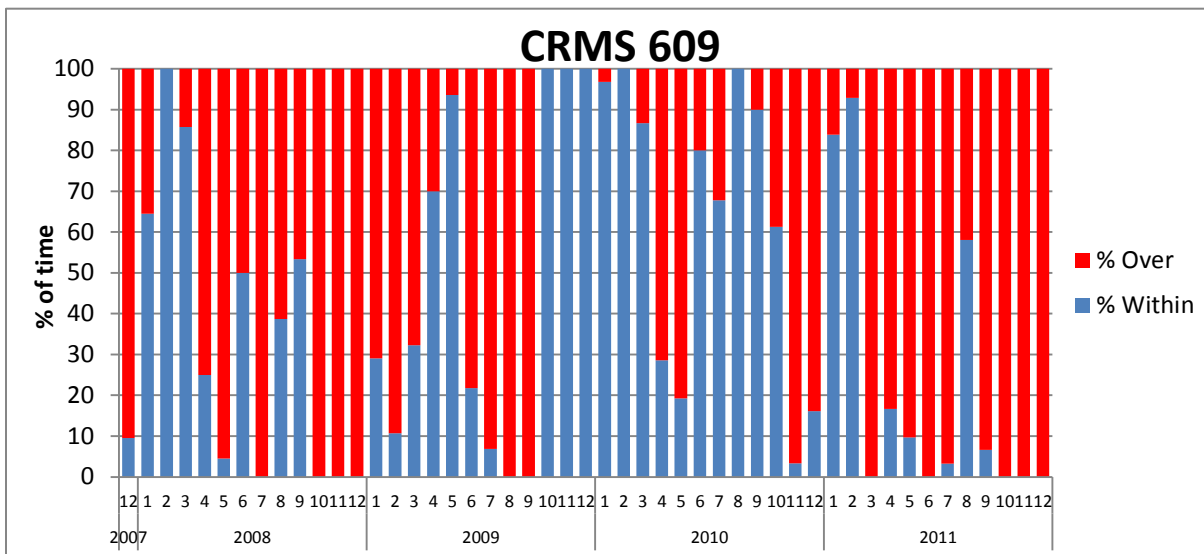
**Figure 4a.** Percentage of month salinities were inside and outside of brackish target range for project station ME16-06 in Muskrat Bayou (Area A).



**Figure 4b.** Percentage of month salinities were inside and outside of brackish target range for reference station CRMS0615, west of the project area.

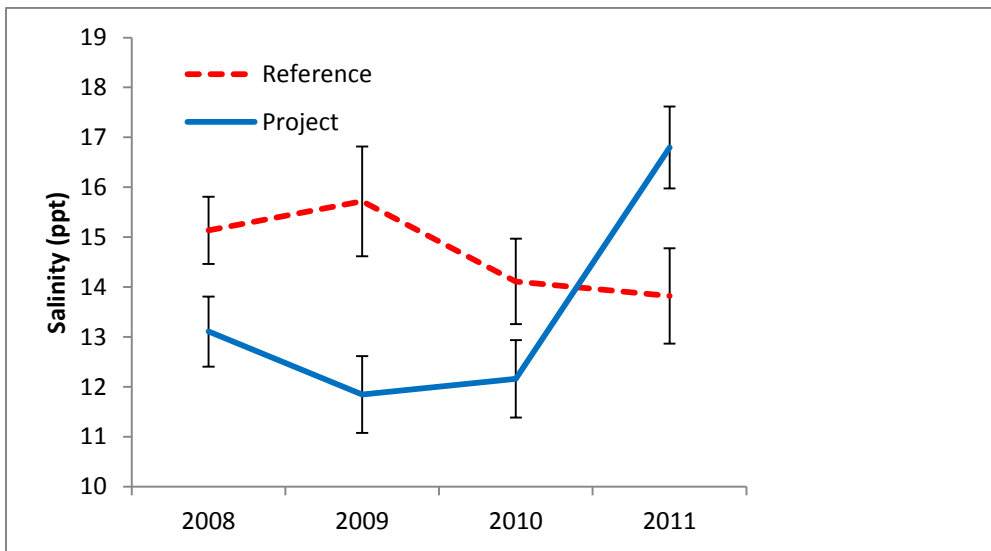


**Figure 4c.** Percentage of month salinities were inside and outside of saline target range for post-construction project station CRMS0599, southwest of Big Constance Bayou control structure.

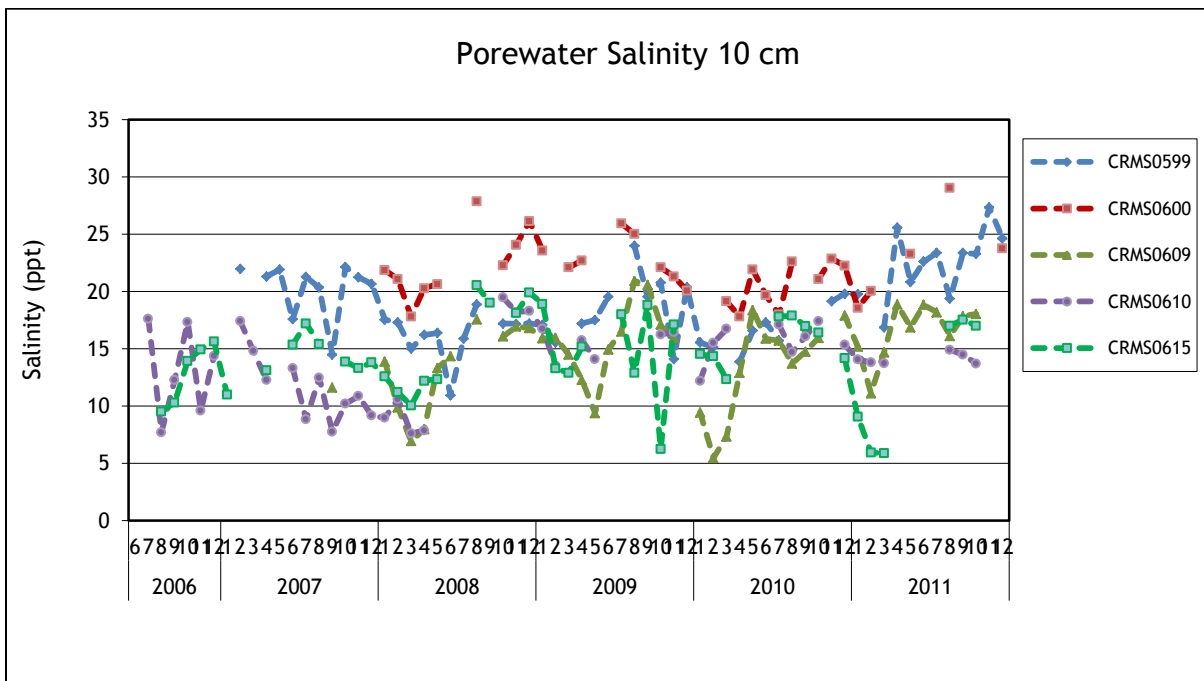


**Figure 4d.** Percentage of month salinities were inside and outside of brackish target range for project station CRMS0609, located southeast of water control structure No. 10 (Area A).

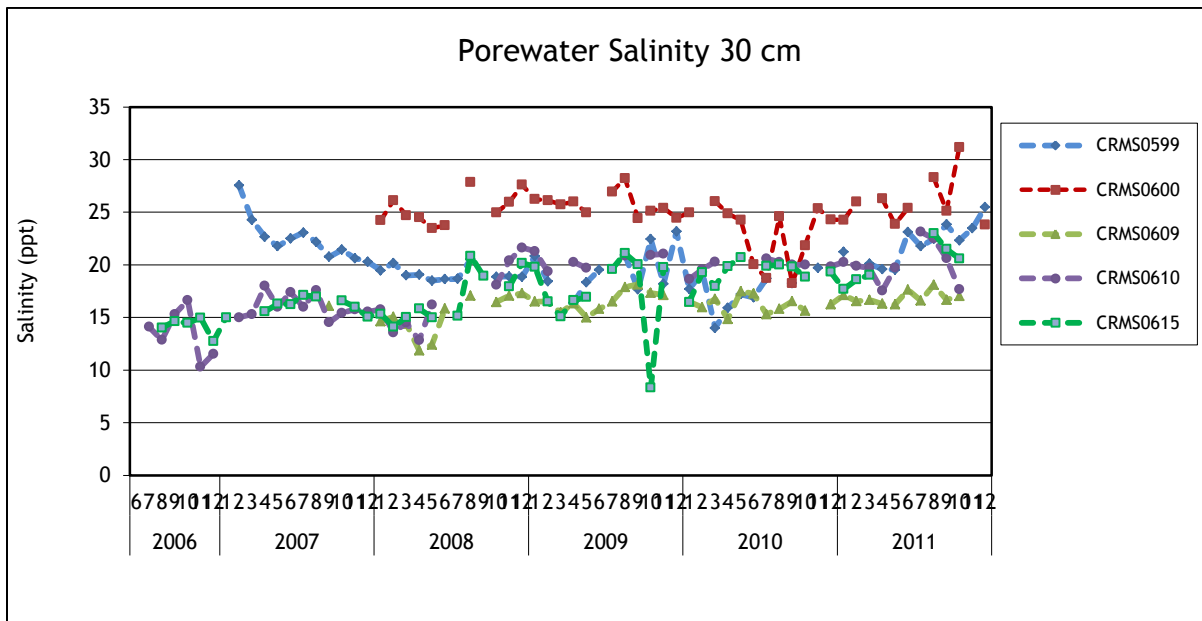




**Figure 4e.** Weekly means and standard errors of continuous salinity collected at project stations (ME16-06, CRMS0609) and reference station CRMS0615 from 2008-2011.



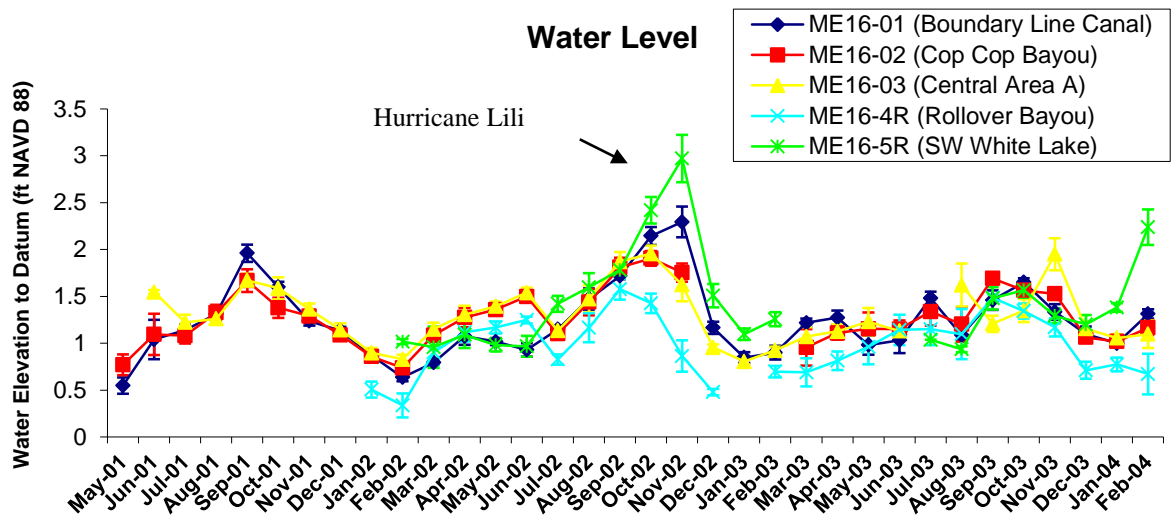
**Figure 5a.** Interstitial water salinity at 10 cm below the soil surface. Error bars, where present, represent the mean of stations in that class for that month  $\pm 1$  Std Err.



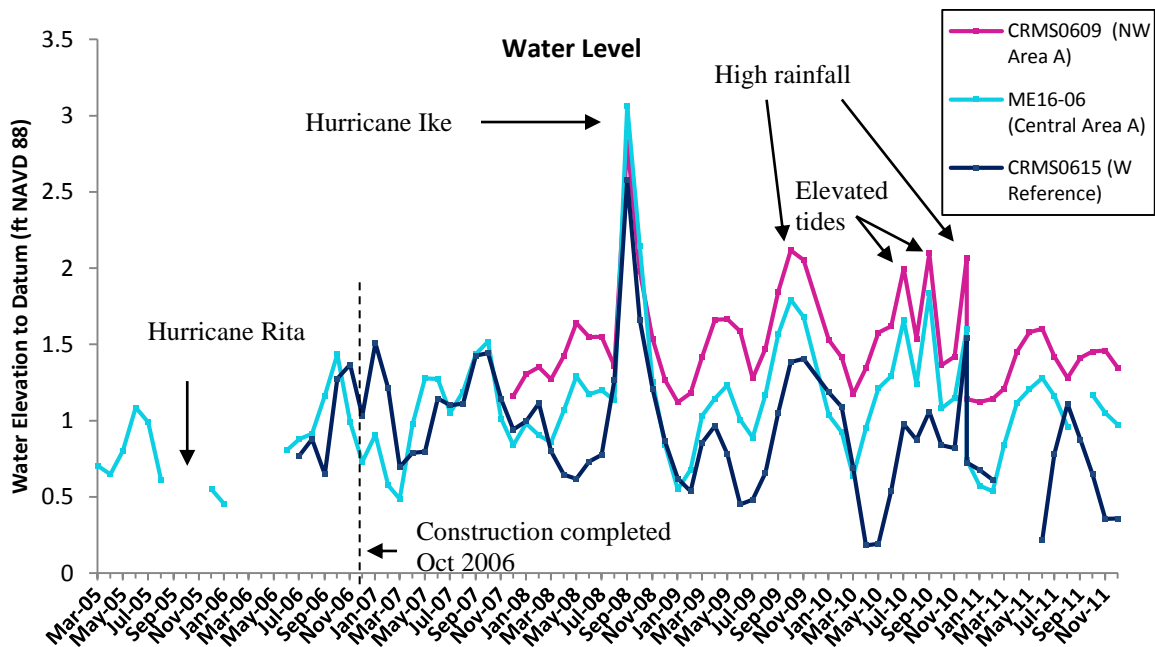
**Figure 5b.** Interstitial water salinity at 30 cm below the soil surface. Error bars, where present, represent the mean of stations in that class for that month  $\pm$  1 Std Err.

#### **Water Level:**

Pre-construction water levels (figure 6a) at the 3 project and 2 reference sites typically followed the same pattern, though water levels were generally higher at ME16-05R during high rain events. Elevated water levels in October 2002 indicate the effects of Hurricane Lili. Because the project was west of the hurricane, storm surge effects were minimal, although the area received 3.03 inches of rainfall (Guthrie Perry, personal communication, August 14, 2008). Hurricane Rita made landfall west of the project in September 2005 (figure 6b). Unfortunately, the recorder at ME16-06 was overtopped by the storm surge and malfunctioned and the water control structures sustained damage. Estimated surge levels in the project area were approximately 9 ft NAVD88 (McGee et al. 2006). The water control structures in the project area became functional again in October of 2006 (Hess 2008). Hurricane Ike struck the coast of Texas in September of 2008. All recorders within the project and reference areas were again overtopped by the storm surge, but according to USGS data, surge levels reached 8-9 ft NAVD88 during this storm (East et al. 2008). Heavy rainfall events occurred in October 2009 and December 2010, which caused increased water levels and reduced salinities throughout the project and reference areas. Elevated tides in July and September of 2010 increased both water levels and salinities.



**Figure 6a.** Monthly means ( $\pm 1$  SE) of water level data collected pre-construction within the ME-16 project and reference areas.



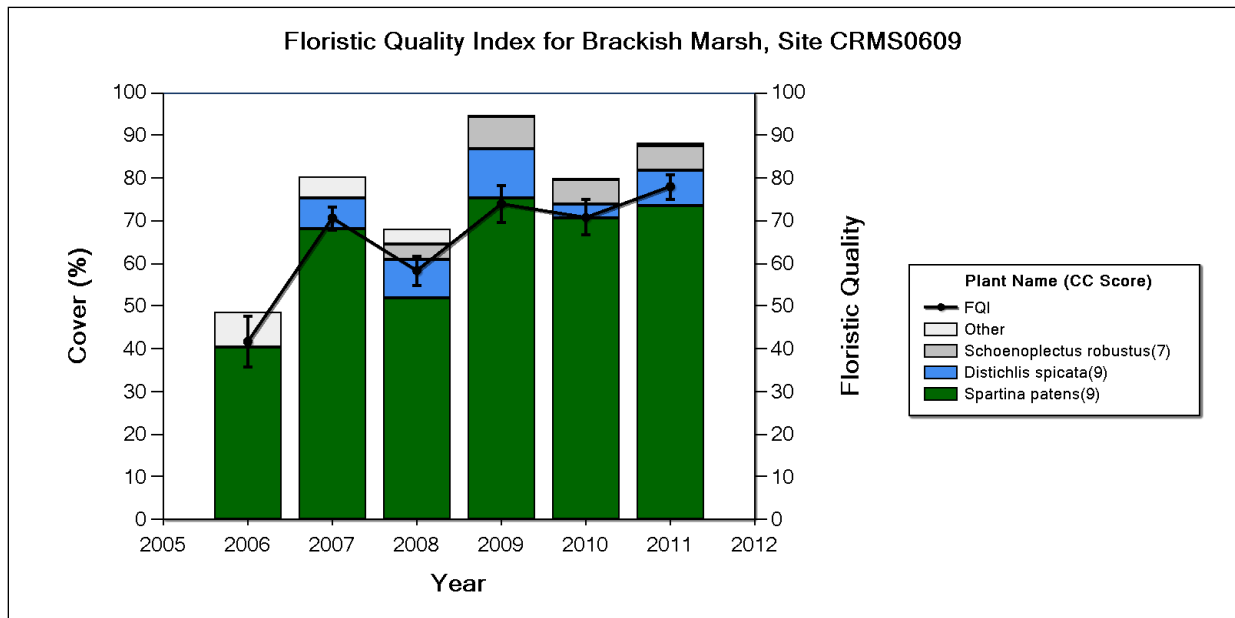
**Figure 6b.** Monthly means of water level data collected pre- and post-construction at ME16-06 and CRMS stations within (609) and outside (615) project area.

### Vegetation:

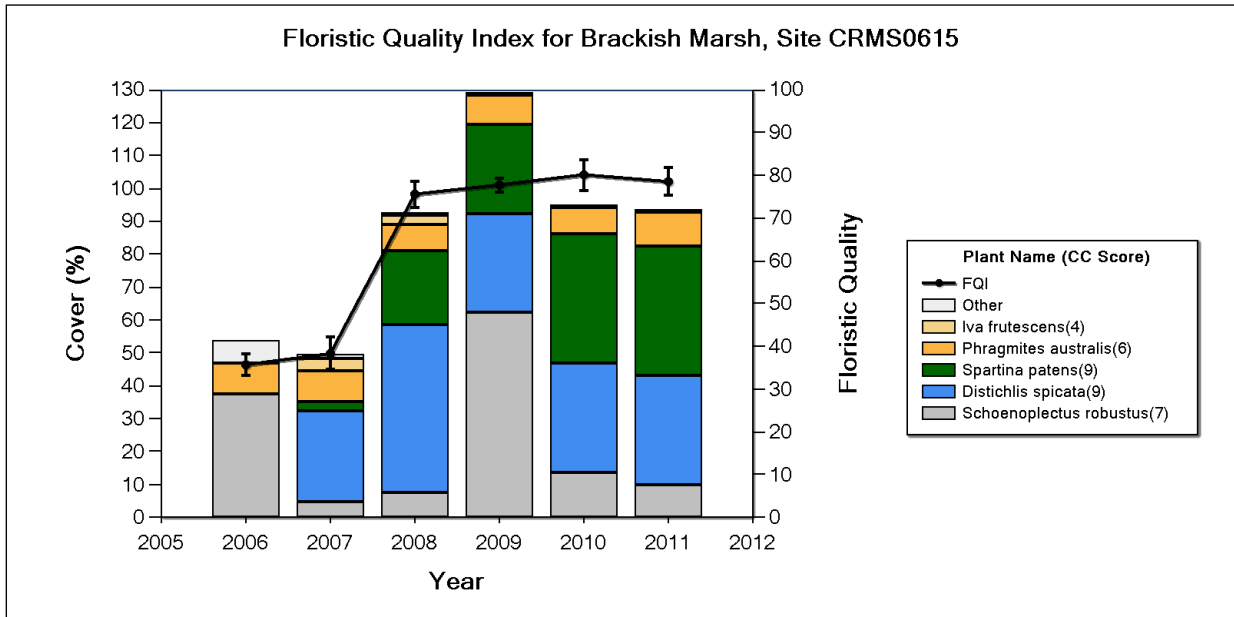
The goal to increase the coverage of emergent wetland vegetation within the project area was achieved; however, the beginning of the data collection period showed the vegetation was likely still stressed from the effects of Hurricane Rita. Cover as well as FQI score increased

for all stations from 2006 to 2007 in the project area, possibly showing a recovery stage from Hurricane Rita (figures 7a – 7e). Brackish site 609, located in the northern part of Area A, showed a slight decrease in cover following Hurricane Ike, but since 2009, cover and FQI score have remained high. This site has been largely dominated by *Spartina patens* through all years sampled, with traces of *Schoenoplectus robustus* and *Distichlis spicata*. The brackish reference site 615 showed a strong recovery in 2009, but has seen a decrease in cover through 2011, though the quality of vegetation has remained the same. *S. patens* and *D. spicata* were co-dominants through most years sampled except 2009, when *S. robustus* was dominant.

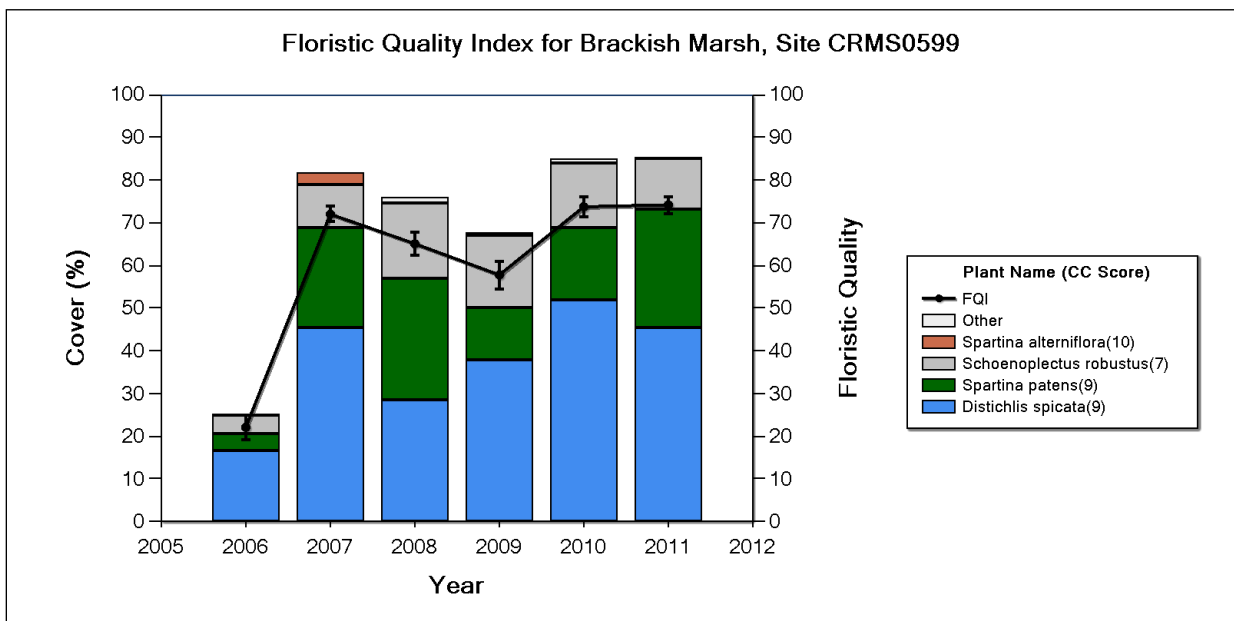
The three CRMS sites within the southern part of the project area (599, 600, 610) are traditionally considered to be saline sites. The 2011 vegetation survey classified these sites as brackish. However, the species surveyed and the interstitial salinities are more representative of a saline marsh. Future surveys will better determine if the sites are seeing a shift in marsh class or just seasonal variation. 599 and 610 were hit hard by Hurricane Rita (cover values were ~20%), but recovered well by 2007. Site 610 saw very little impact from Hurricane Ike and has shown a steady increase in both CC score and cover since 2006. Sites 0599 and 600 showed similar patterns, in that it took a couple of years to recover to pre-storm conditions following Hurricane Ike. These sites all have similar species assemblages to the brackish sites above (*S. patens*, *D. spicata*, *S. robustus*). The difference appears to be a larger concentration of *D. Spicata* and also the presence of *Spartina alterniflora*, both of which are more salt tolerant species. In 2011, *Batis maritima*, a saline species, was also detected at station 600.



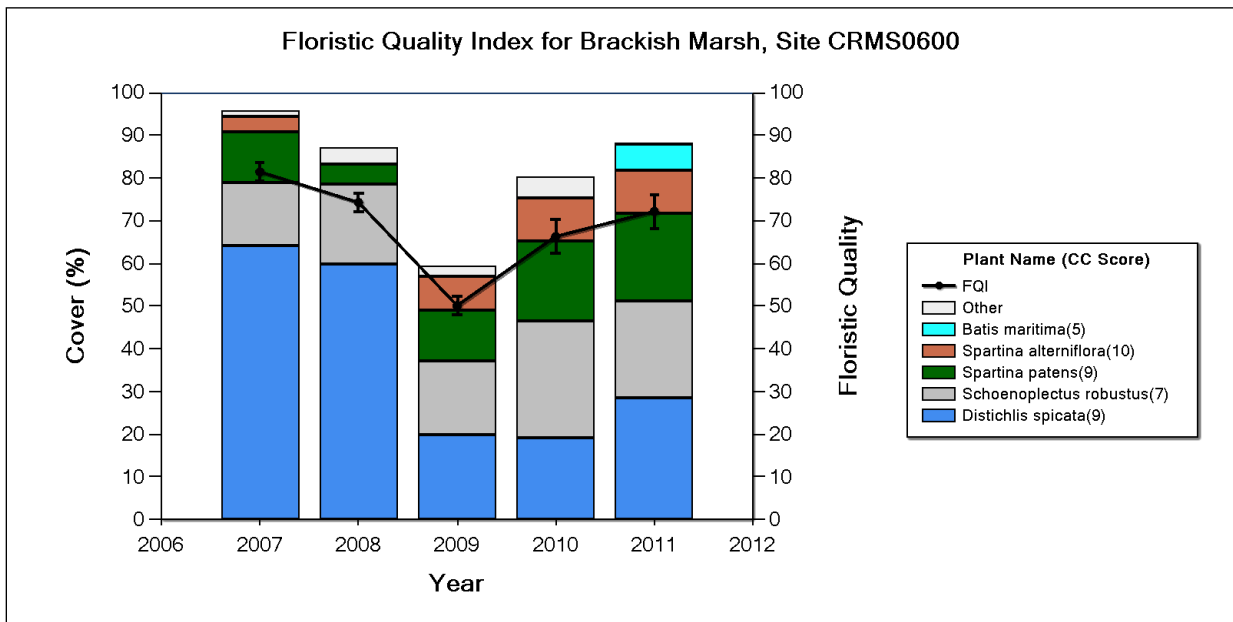
**Figure 7a.** Percent coverage and floristic quality index of species collected from CRMS site 609 within the project area in years 2006 – 2011. The Coefficient of Conservatism (CC) scores represent the quality of individual species from 1 to 10 where 1 represents disturbance species and 10 indicates stable species.



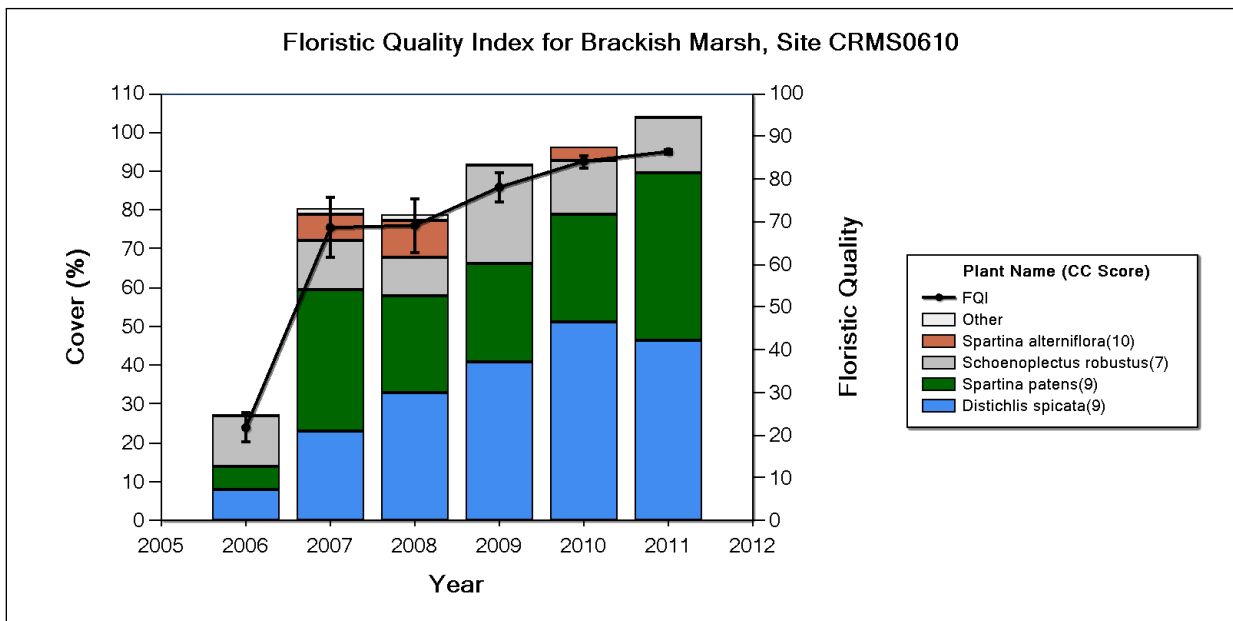
**Figure 7b.** Percent coverage and floristic quality index of species collected from CRMS reference site 615 in years 2006 – 2011. The CC scores represent the quality of individual species from 1 to 10 where 1 represents disturbance species and 10 indicates stable species.



**Figure 7c.** Percent coverage and floristic quality index of species collected from CRMS site 599 within the project area in 2006 and 2007. The CC scores represent the quality of individual species from 1 to 10 where 1 represents disturbance species and 10 indicates stable species.



**Figure 7d.** Percent coverage and floristic quality index of species collected from CRMS site 600 within the project area in years 2007 – 2011. The CC scores represent the quality of individual species from 1 to 10 where 1 represents disturbance and 10 indicates stable species.



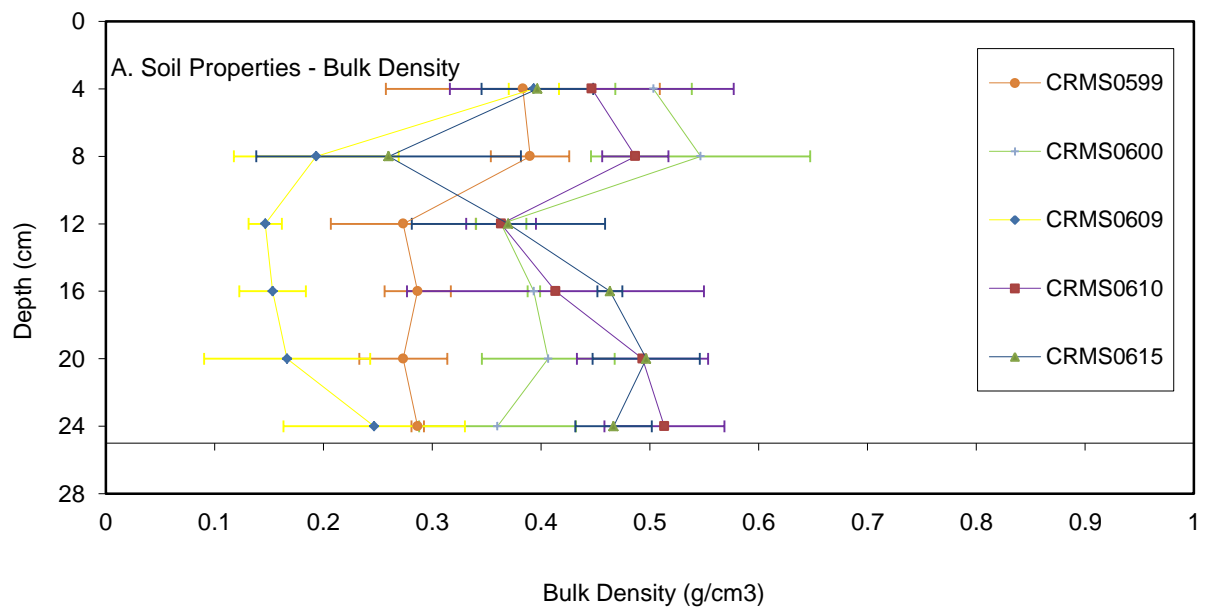
**Figure 7e.** Percent coverage and floristic quality index of species collected from CRMS site 610 within the project area in years 2006 - 2011. The CC scores represent the quality of individual species from 1 to 10 where 1 represents disturbance and 10 indicates stable species.



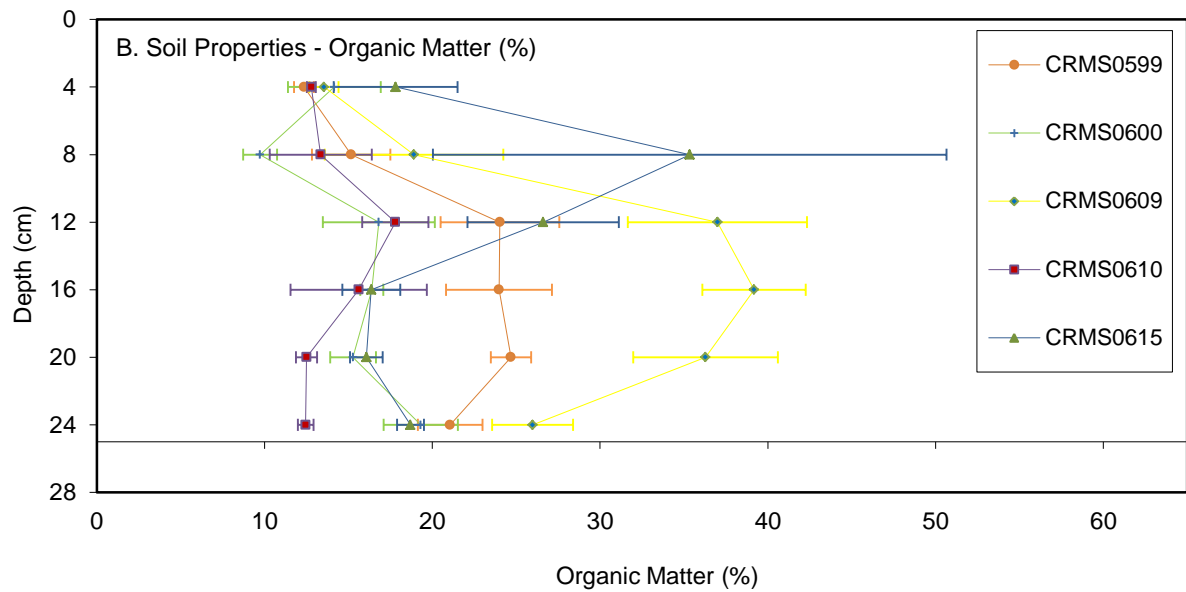
## CRMS Supplemental:

### Soils:

Soil samples were collected at each of the CRMS-Wetlands sites in the project area (599, 600, 609, 610) and selected reference site 615. The soil properties data were sampled in 4 cm increments. All cores were sampled after Hurricane Rita. Figures for mean bulk density and percent organic matter (OM%) by CRMS station are presented in figures 8a and 8b. Higher bulk densities occurred at project area sites 610 and 600 near the Gulf of Mexico, which would be expected since denser soils tend to occur in salt marshes. These sites also had the lowest OM% (<20% throughout the core). Lower bulk densities and higher OM% were found in the bottom half of the core at site 609.



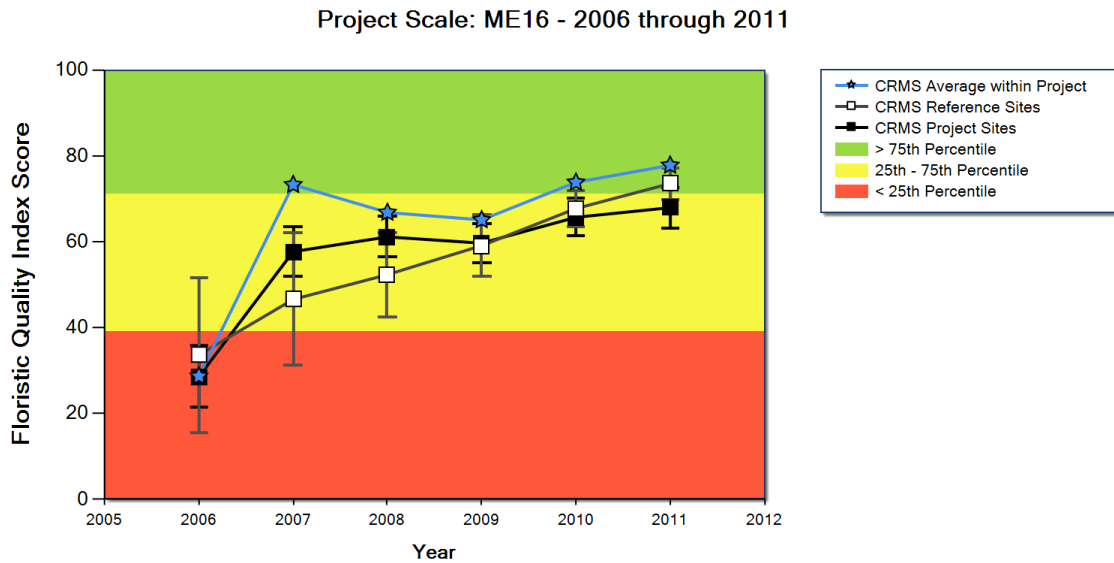
**Figure 8a.** Mean  $\pm$  1 Standard error of soil bulk density collected at project and reference CRMS stations.



**Figure 8b.** Mean  $\pm$  1 Standard error of soil organic matter collected at project and reference CRMS-Wetlands stations.

### **Vegetation:**

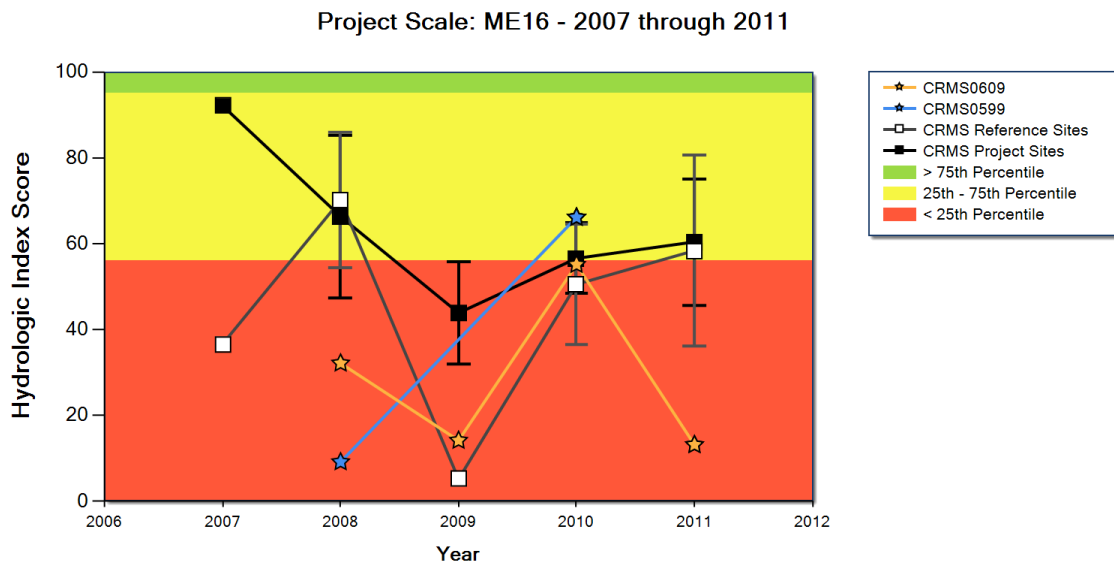
Since vegetation data collection started, CRMS sites within the ME-16 project area have had higher FQI scores compared to other CWPPRA project sites and reference sites within similar marsh types of the Mermentau Basin in all years except 2006 (The project did not become operational until late 2006). In addition, in the last two years, project sites have had a high distribution ( $>75^{\text{th}}$  percentile) compared to sites coastwide (figure 9).



**Figure 9.** FQI scores of CRMS sites averaged within the ME-16 project area shown over time relative to all other CRMS sites (Reference and CWPPRA projects) with similar marsh types within the Mermentau Basin.

**Hydrologic Index (HI):**

The HI scores of the ME-16 project sites were generally low when compared to other project and reference stations in similar marsh types in the basin and coastwide. Scores were below 40 in all years except 2010, when there was not a significant difference between the two ME-16 sites and other sites in the basin.



**Figure 10.** HI scores of CRMS sites 599 and 609 within the ME-16 project area shown over time relative to all other CRMS sites (Reference and CWPPRA projects) within similar marsh types within the Mermentau Basin.

## **V. Conclusions**

### **a. Project Effectiveness**

The project is effective at reducing salinities in Area A during normal climatic conditions. Brackish marshes in the project area have seen lower salinities compared to the reference area when adequate rainfall exists.

Hurricanes Rita and Ike caused mild land loss in the project area, but the project appeared to be recovering by 2010. Future analysis will help to better determine the project's effect on land change.

Interstitial water salinities were highest along the gulf shoreline averaging above 20 ppt. In the brackish marshes of Area A, average salinities were lower, but were still above the target range of 11 ppt.

Vegetation in the project area was severely impacted by Hurricane Rita and to a lesser extent by Hurricane Ike. Through 2011, the cover and quality of vegetation has recovered and remained high at project area sites. Floristic quality of species within the project area rated highly when compared to similar sites within the basin.

Overall the structural components of Freshwater Introduction South of Hwy 82 Project are in good condition and functioning as intended. The recent maintenance event of placing rip rap provides armament for the structures.

### **b. Recommended Improvements**

- Lifting chains should be provided on the flapgates at the New Dyson, New Cop Cop, and Structure No. 10.
- Rock rip rap should be filled in closer to the structure at Structure No. 10.
- Concrete on the Little Constance Structure which was damaged by the rock placement during the maintenance event needs repair.

### **c. Lessons Learned**

The use of spray dredge technology in performing the enlargement of Grand Volle Channels and Highway 82 Channel enlargement was very beneficial in that the spoil material from these areas was thinly spread out over the existing marsh and did not have any adverse effects as compared to conventional bucket dredging with built up spoil bank. Within a few months' time, the spray dredge disposal areas were barely visible and the marsh was in pre-construction condition.

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## **APPENDIX A**

### **(Inspection Photographs)**



**Photo No. 1,** New Cop-Cop Structure, rock placement on outlet side of structure.



**Photo No. 2,** New Cop-Cop Structure, inlet side of structure.





**Photo No. 3,** Structure No. 12, rock placement on outlet side of structure.



**Photo No. 4,** Structure No. 12, rock placement on inlet side of structure.





**Photo No. 5,** Structure No. 10, rock placement on inlet side of structure.



**Photo No. 6,** Structure No. 10, rock placement on outlet side of structure.





**Photo No. 7,** New Dyson Structure, rock placement on outlet side.



**Photo No. 8,** New Dyson Structure, rock placement on inlet side.





**Photo No. 9,** Little Constance Structure, rock placement on east side of structure.



**Photo No. 10,** Little Constance Structure, rock placement on west side of structure.



**Photo No. 11, Earthen Terraces**



**Photo No. 12, Earthen Terraces**



**APPENDIX B**  
**(Three Year Budget Projection)**

**FRESHWATER INTRODUCTION S. OF HWY 82/ ME-16 / PPL 9**  
**Three-Year Operations & Maintenance Budgets 07/01/2012 - 06/30/2015**

<u>Project Manager</u>	<u>O &amp; M Manager</u>	<u>Federal Sponsor</u>	<u>Prepared By</u>
Darrell Pontiff	Dion Broussard	USFWS	Dion Broussard

	2012/2013 (-6)	2013/2014 (-7)	2014/2015 (-8)
<b>Maintenance Inspection</b>	\$ 6,269.00	\$ 6,457.00	\$ 6,651.00
<b>Structure Operation</b>			
<b>State Administration</b>		\$ -	\$ -
<b>Federal Administration</b>		\$ -	\$ -
<b>Maintenance/Rehabilitation</b>			

**12/13 Description:**

E&D	\$0.00
Construction	\$0.00
Construction Oversight	\$0.00
Sub Total - Maint. And Rehab.	\$ -

**13/14 Description:**

E&D	\$ -
Construction	\$ -
Construction Oversight	\$ -
Sub Total - Maint. And Rehab.	\$ -

**14/15 Description:**

E&D	\$ -
Construction	\$ -
Construction Oversight	\$ -
Sub Total - Maint. And Rehab.	\$ -

	2012/2013 (-6)	2013/2014 (-7)	2014/2015 (-8)
<b>Total O&amp;M Budgets</b>	\$ 6,269.00	\$ 6,457.00	\$ 6,651.00

<b>O &amp; M Budget (3 yr Total)</b>	<b>\$ 19,377.00</b>
<b>Unexpended O &amp; M Budget</b>	<b>\$ 34,556.00</b>
<b>Remaining O &amp; M Budget (Projected)</b>	<b>\$ 15,179.00</b>

# **OPERATION AND MAINTENANCE BUDGET WORKSHEET**

FRESHWATER INTRODUCTION S OF HWY 82 PROJECT / PROJECT NO. ME-16 / PPL NO. 9 / 2012/2013

DESCRIPTION	UNIT	EST. QTY.	UNIT PRICE	ESTIMATED TOTAL
O&M Inspection and Report	EACH	1	\$6,269.00	\$6,269.00
General Structure Maintenance	LUMP	0	\$0.00	\$0.00
Engineering and Design	LUMP	0	\$0.00	\$0.00
Operations Contract	LUMP	0	\$0.00	\$0.00
Construction Oversight	LUMP	0	\$0.00	\$0.00

## **ADMINISTRATION**

LDNR / CRD Admin.	LUMP	0	\$0.00	\$0.00
FEDERAL SPONSOR Admin.	LUMP	0	\$0.00	\$0.00
SURVEY Admin.	LUMP	0	\$0.00	\$0.00
OTHER				\$0.00
<b>TOTAL ADMINISTRATION COSTS:</b>				<b>\$0.00</b>

## **MAINTENANCE / CONSTRUCTION**

### **SURVEY**

SURVEY DESCRIPTION:					
	Secondary Monument	EACH	0	\$0.00	\$0.00
	Staff Gauge / Recorders	EACH	0	\$0.00	\$0.00
	Marsh Elevation / Topography	LUMP	0	\$0.00	\$0.00
	TBM Installation	EACH	0	\$0.00	\$0.00
	OTHER				\$0.00
	TOTAL SURVEY COSTS:				\$0.00

### **GEOTECHNICAL**

GEOTECH DESCRIPTION:					
	Borings	EACH	0	\$0.00	\$0.00
	OTHER				\$0.00
	TOTAL GEOTECHNICAL COSTS:				\$0.00

### **CONSTRUCTION**

CONSTRUCTION DESCRIPTION:						
	Rip Rap	LIN FT	TON / FT	TONS	UNIT PRICE	
	Rock Rip rap	0	0.0	0	\$0.00	\$0.00
	Aggregate Surface Course	0	0.0	0	\$0.00	\$0.00
		0	0.0	0	\$0.00	\$0.00
	Filter Cloth / Geogrid Fabric		SQ YD	0	\$0.00	\$0.00
	Navigation Aid		EACH	0	\$0.00	\$0.00
	Signage		EACH	0	\$0.00	\$0.00
	General Excavation / Fill		CU YD	0	\$0.00	\$0.00
	Dredging		CU YD	0	\$0.00	\$0.00
	Sheet Piles (Lin Ft or Sq Yds)			0	\$0.00	\$0.00
	Timber Piles (each or lump sum)			0	\$0.00	\$0.00
	Timber Members (each or lump sum)			0	\$0.00	\$0.00
	Hardware		LUMP	0	\$0.00	\$0.00
	Materials		LUMP	0	\$0.00	\$0.00
	Mob / Demob		LUMP	0	\$0.00	\$0.00
	Contingency		LUMP	0	\$0.00	\$0.00
	General Structure Maintenance		LUMP	0	\$0.00	\$0.00
	OTHER				\$0.00	\$0.00
	OTHER				\$0.00	\$0.00
OTHER				\$0.00	\$0.00	
TOTAL CONSTRUCTION COSTS:					\$0.00	

**TOTAL OPERATIONS AND MAINTENANCE BUDGET:** **\$6,269.00**

**OPERATION AND MAINTENANCE BUDGET WORKSHEET**  
**FRESHWATER INTRODUCTION S OF HWY 82 PROJECT / PROJECT NO. ME-16 / PPL NO. 9 / 2013/2014**

DESCRIPTION	UNIT	EST. QTY.	UNIT PRICE	ESTIMATED TOTAL
O&M Inspection and Report	EACH	1	\$6,457.00	<b>\$6,457.00</b>
General Structure Maintenance	LUMP	0	\$0.00	<b>\$0.00</b>
Engineering and Design	LUMP	0	\$0.00	<b>\$0.00</b>
Operations Contract	LUMP	0	\$0.00	<b>\$0.00</b>
Construction Oversight	LUMP	0	\$0.00	<b>\$0.00</b>

**ADMINISTRATION**

LDNR / CRD Admin.	LUMP	0	\$0.00	\$0.00
FEDERAL SPONSOR Admin.	LUMP	0	\$0.00	\$0.00
SURVEY Admin.	LUMP	0	\$0.00	\$0.00
OTHER				\$0.00
<b>TOTAL ADMINISTRATION COSTS:</b>				<b>\$0.00</b>

**MAINTENANCE / CONSTRUCTION**

**SURVEY**

SURVEY DESCRIPTION:	Add staff gage.			
Secondary Monument	EACH	0	\$0.00	\$0.00
Staff Gauge / Recorders	EACH	0	\$0.00	\$0.00
Marsh Elevation / Topography	LUMP	0	\$0.00	\$0.00
TBM Installation	EACH	0	\$0.00	\$0.00
OTHER				\$0.00
<b>TOTAL SURVEY COSTS:</b>				<b>\$0.00</b>

**GEOTECHNICAL**

GEOTECH DESCRIPTION:				
Borings	EACH	0	\$0.00	\$0.00
OTHER				\$0.00
<b>TOTAL GEOTECHNICAL COSTS:</b>				<b>\$0.00</b>

**CONSTRUCTION**

CONSTRUCTION DESCRIPTION:					
Rip Rap	LIN FT	TON / FT	TONS	UNIT PRICE	
Rock Rip rap	0	0.0	0	\$0.00	\$0.00
Aggregate Surface Course	0	0.0	0	\$0.00	\$0.00
	0	0.0	0	\$0.00	\$0.00
Filter Cloth / Geogrid Fabric	SQ YD	0	\$0.00	\$0.00	\$0.00
Navigation Aid	EACH	0	\$0.00	\$0.00	\$0.00
Signage	EACH	0	\$0.00	\$0.00	\$0.00
General Excavation / Fill	CU YD	0	\$0.00	\$0.00	\$0.00
Dredging	CU YD	0	\$0.00	\$0.00	\$0.00
Sheet Piles (Lin Ft or Sq Yds)		0	\$0.00	\$0.00	\$0.00
Timber Piles (each or lump sum)		0	\$0.00	\$0.00	\$0.00
Timber Members (each or lump sum)		0	\$0.00	\$0.00	\$0.00
Hardware	LUMP	0	\$0.00	\$0.00	\$0.00
Materials	LUMP	0	\$0.00	\$0.00	\$0.00
Mob / Demob	LUMP	0	\$0.00	\$0.00	\$0.00
Contingency	LUMP	0	\$0.00	\$0.00	\$0.00
General Structure Maintenance	LUMP	0	\$0.00	\$0.00	\$0.00
OTHER			\$0.00	\$0.00	\$0.00
OTHER			\$0.00	\$0.00	\$0.00
OTHER			\$0.00	\$0.00	\$0.00
<b>TOTAL CONSTRUCTION COSTS:</b>					<b>\$0.00</b>

**TOTAL OPERATIONS AND MAINTENANCE BUDGET: \$6,457.00**

**OPERATION AND MAINTENANCE BUDGET WORKSHEET**  
**FRESHWATER INTRODUCTION S OF HWY 82 PROJECT / PROJECT NO. ME-16 / PPL NO. 9 / 2014/2015**

DESCRIPTION	UNIT	EST. QTY.	UNIT PRICE	ESTIMATED TOTAL
O&M Inspection and Report	EACH	1	\$6,651.00	<b>\$6,651.00</b>
General Structure Maintenance	LUMP	0	\$0.00	<b>\$0.00</b>
Engineering and Design	LUMP	0	\$0.00	<b>\$0.00</b>
Operations Contract	LUMP	0	\$0.00	<b>\$0.00</b>
Construction Oversight	LUMP	0	\$0.00	<b>\$0.00</b>

**ADMINISTRATION**

LDNR / CRD Admin.	LUMP	0	\$0.00	\$0.00
FEDERAL SPONSOR Admin.	LUMP	0	\$0.00	\$0.00
SURVEY Admin.	LUMP	0	\$0.00	\$0.00
OTHER				\$0.00
<b>TOTAL ADMINISTRATION COSTS:</b>				<b>\$0.00</b>

**MAINTENANCE / CONSTRUCTION**

**SURVEY**

SURVEY DESCRIPTION:	Add staff gage.			
Secondary Monument	EACH	0	\$0.00	\$0.00
Staff Gauge / Recorders	EACH	0	\$0.00	\$0.00
Marsh Elevation / Topography	LUMP	0	\$0.00	\$0.00
TBM Installation	EACH	0	\$0.00	\$0.00
OTHER				\$0.00
<b>TOTAL SURVEY COSTS:</b>				<b>\$0.00</b>

**GEOTECHNICAL**

GEOTECH DESCRIPTION:				
Borings	EACH	0	\$0.00	\$0.00
OTHER				\$0.00
<b>TOTAL GEOTECHNICAL COSTS:</b>				<b>\$0.00</b>

**CONSTRUCTION**

CONSTRUCTION DESCRIPTION:					
Rip Rap	LIN FT	TON / FT	TONS	UNIT PRICE	
Rock Rip rap	0	0.0	0	\$0.00	\$0.00
Aggregate Surface Course	0	0.0	0	\$0.00	\$0.00
	0	0.0	0	\$0.00	\$0.00
Filter Cloth / Geogrid Fabric	SQ YD	0	\$0.00	\$0.00	\$0.00
Navigation Aid	EACH	0	\$0.00	\$0.00	\$0.00
Signage	EACH	0	\$0.00	\$0.00	\$0.00
General Excavation / Fill	CU YD	0	\$0.00	\$0.00	\$0.00
Dredging	CU YD	0	\$0.00	\$0.00	\$0.00
Sheet Piles (Lin Ft or Sq Yds)		0	\$0.00	\$0.00	\$0.00
Timber Piles (each or lump sum)		0	\$0.00	\$0.00	\$0.00
Timber Members (each or lump sum)		0	\$0.00	\$0.00	\$0.00
Hardware	LUMP	0	\$0.00	\$0.00	\$0.00
Materials	LUMP	0	\$0.00	\$0.00	\$0.00
Mob / Demob	LUMP	0	\$0.00	\$0.00	\$0.00
Contingency	LUMP	0	\$0.00	\$0.00	\$0.00
General Structure Maintenance	LUMP	0	\$0.00	\$0.00	\$0.00
OTHER			\$0.00	\$0.00	\$0.00
OTHER			\$0.00	\$0.00	\$0.00
OTHER			\$0.00	\$0.00	\$0.00
<b>TOTAL CONSTRUCTION COSTS:</b>					<b>\$0.00</b>

**TOTAL OPERATIONS AND MAINTENANCE BUDGET: \$6,651.00**

## **APPENDIX C**

### **(Field Inspection Notes)**

MAINTENANCE INSPECTION REPORT CHECK SHEET					
Project No. / Name: ME-16 Freshwater Intro. S of Hwy 82			Date of Inspection: October 26, 2011 Time: 10:30 am		
Structure No. Earthen Terraces			Inspector(s): Dion Broussard, Mark Mouldous, Catherine Ricks and Tim Harper (CPRA)		
Structure Description: 26,000 LF "duck wing" earthen terraces			Water Level Inside: Outside:		
Type of Inspection: Annual			Weather Conditions: Sunny and cool		
Item	Condition	Physical Damage	Corrosion	Photo #	Observations and Remarks
Steel Bulkhead / Caps	N/A				
Steel Grating	N/A				
Stop Logs	N/A				
Hardware	N/A				
Timber Piles	N/A				
Timber Walkway	N/A				
Timber Wales	N/A				
Galv. Pile Caps	N/A				
Cables	N/A				
Signage / Supports	N/A				
Staff Gages	N/A				
Rip Rap (fill)	N/A				
Earthen Terraces	Good			11 & 12	Fully vegetated.
What are the conditions of the existing levees? Are there any noticeable breaches? Settlement of rock plugs and rock weirs? Position of stoplogs at the time of the inspection? Are there any signs of vandalism?					

MAINTENANCE INSPECTION REPORT CHECK SHEET					
Project No. / Name: ME-16 Freshwater Intro. S of Hwy 82			Date of Inspection: October 27, 2011 Time: 1:00 pm		
Structure No. Little Constance			Inspector(s): Dion Broussard, Dewey Billodeau, Mark Mouldous, Darrell Pontiff (CPRA), Darryl Clark (USFWS) Tanita Baker (EJES) for other inspections		
Structure Description: Variable crest concrete control structure Four 4'-8" X 6'-8" flapgates w/ stop logs			Water Level Inside: Outside:		
Type of Inspection: Annual			Weather Conditions: Sunny and cool		
Item	Condition	Physical Damage	Corrosion	Photo #	Observations and Remarks
Concrete Control Structure	Good				Contractor needs to repair section of broken concrete on structure which occurred during the rock maintenance event.
Flap Gates	Good				
Stop Logs	Good				
Hardware	Good				
Timber Piles	N/A				
Timber Walkway	N/A				
Timber Wales	N/A				
Galv. Pile Caps	N/A				
Cables	Good				
Signage / Supports	N/A				
Staff Gages	N/A				
Rip Rap (fill)	Good			9 & 10	Looks Good.
Earthen Embankment	N/A				
What are the conditions of the existing levees? Are there any noticeable breaches? Settlement of rock plugs and rock weirs? Position of stoplogs at the time of the inspection? Are there any signs of vandalism?					



MAINTENANCE INSPECTION REPORT CHECK SHEET					
Project No. / Name: ME-16 Freshwater Intro. S of Hwy 82			Date of Inspection: October 27, 2011 Time: 12:30 pm		
Structure No. New Dyson			Inspector(s): Dion Broussard, Dewey Billodeau, Mark Mouledous, Darrell Pontiff (CPRA), Darryl Clark (USFWS) Tanita Baker (EJES) for other inspections		
Structure Description: Variable crest aluminum culverts Four 48" diameter culvs. w/ flapgates and stop logs			Water Level Inside: Outside: Weather Conditions: Sunny and cool		
Type of Inspection: Annual					
Item	Condition	Physical Damage	Corrosion	Photo #	Observations and Remarks
Flapgates	Good				Contractor needs to provide lifting chains for opening flapgates.
Steel Grating	Good				
Stop Logs	Good				
Hardware	Good				
Timber Piles	Good				
Timber Walkway					
Timber Wales	Good				
Galv. Pile Caps	Good				
Culverts	Good				Leaks discovered by the contractor at the interface between the culverts and headwall have been repaired.
Signage / Supports	N/A				
Staff Gages					
Rip Rap (fill)	Good			7 & 8	
Earthen Embankment	Good			7 & 8	
What are the conditions of the existing levees?					
Are there any noticeable breaches?					
Settlement of rock plugs and rock weirs?					
Position of stoplogs at the time of the inspection?					
Are there any signs of vandalism?					

MAINTENANCE INSPECTION REPORT CHECK SHEET					
Project No. / Name: ME-16 Freshwater Intro. S of Hwy 82			Date of Inspection: October 27, 2011 Time: 11:00 am		
Structure No. New Cop Cop			Inspector(s): Dion Broussard, Dewey Billodeau, Mark Mouledous, Darrell Pontiff (CPRA), Darryl Clark (USFWS) Tanita Baker (EJES) for other inspections		
Structure Description: Variable crest aluminum culverts Four 48" diameter culvs. w/ flapgates and stop logs			Water Level Inside: Outside: Weather Conditions: Sunny and cool		
Type of Inspection: Annual					
Item	Condition	Physical Damage	Corrosion	Photo #	Observations and Remarks
Flapgates	Good				Contractor needs to provide lifting chains for opening flapgates.
Steel Grating	Good			2	
Stop Logs	Good				
Hardware	Good				
Timber Piles	Good			1	
Timber Walkway					
Timber Wales	Good				
Galv. Pile Caps	Good				
Culverts	Good				Leaks discovered by the contractor at the interface of the culvert and headwall have been repaired by the contractor.
Signage / Supports	N/A				
Staff Gages					
Rip Rap (fill)	Good			1 & 2	
Earthen Embankment	Good				
What are the conditions of the existing levees?					
Are there any noticeable breaches?					
Settlement of rock plugs and rock weirs?					
Position of stoplogs at the time of the inspection?					
Are there any signs of vandalism?					

MAINTENANCE INSPECTION REPORT CHECK SHEET					
Project No. / Name: ME-16 Freshwater Intro. S of Hwy 82			Date of Inspection: October 27, 2011 Time: 12:00 pm		
Structure No. 10			Inspector(s): Dion Broussard, Dewey Billodeau, Mark Mouledous, Darrell Pontiff (CPRA), Darryl Clark (USFWS)		
Structure Description: Variable crest aluminum culverts Three 48" diameter culvs. w/ flapgates and stop logs			Water Level Inside: Outside: Weather Conditions: Sunny and cool		
Type of Inspection: Annual					
Item	Condition	Physical Damage	Corrosion	Photo #	Observations and Remarks
Flapgates	Good				Contractor needs to provide lifting chains for opening the flapgates.
Steel Grating	Good			5	
Stop Logs	Good				
Hardware	Good				
Timber Piles	Good			6	
Timber Walkway					
Timber Wales	Good				
Galv. Pile Caps	Good			6	
Cables	N/A				
Signage / Supports	N/A				
Staff Gages					
Rip Rap (fill)	Good			5 & 6	Contractor needs to move some rock closer to the structure.
Earthen Embankment	Good			5 & 6	
What are the conditions of the existing levees?					
Are there any noticeable breaches?					
Settlement of rock plugs and rock weirs?					
Position of stoplogs at the time of the inspection?					
Are there any signs of vandalism?					

MAINTENANCE INSPECTION REPORT CHECK SHEET					
Project No. / Name: ME-16 Freshwater Intro. S of Hwy 82			Date of Inspection: October 27, 2011 Time: 11:30 am		
Structure No. 12			Inspector(s): Dion Broussard, Dewey Billodeau, Mark Mouledous, Darrell Pontiff (CPRA), Darryl Clark (USFWS)		
Structure Description: Variable crest aluminum culverts Three 48" diameter culvs. w/ flapgates and stop logs			Water Level Inside: Outside: Weather Conditions: Sunny and cool		
Type of Inspection: Annual					
Item	Condition	Physical Damage	Corrosion	Photo #	Observations and Remarks
Steel Bulkhead / Caps	N/A				
Steel Grating	Good				
Stop Logs	Good				
Hardware	Good				
Timber Piles	Good				
Timber Wales	Good				
Galv. Pile Caps	Good				
Cables	N/A				
Signage / Supports	N/A				
Staff Gages					
Rip Rap (fill)	Good			3 & 4	
Earthen Embankment	Fair			3 & 4	
What are the conditions of the existing levees?					
Are there any noticeable breaches?					
Settlement of rock plugs and rock weirs?					
Position of stoplogs at the time of the inspection?					
Are there any signs of vandalism?					

**Appendix D**  
**(Rockefeller Refuge Operations & Monitoring Report)**  
**Provided by Wildlife and Fisheries Staff**

## Hwy. 82 Water Control Structure Management Summary

**Table 1.**

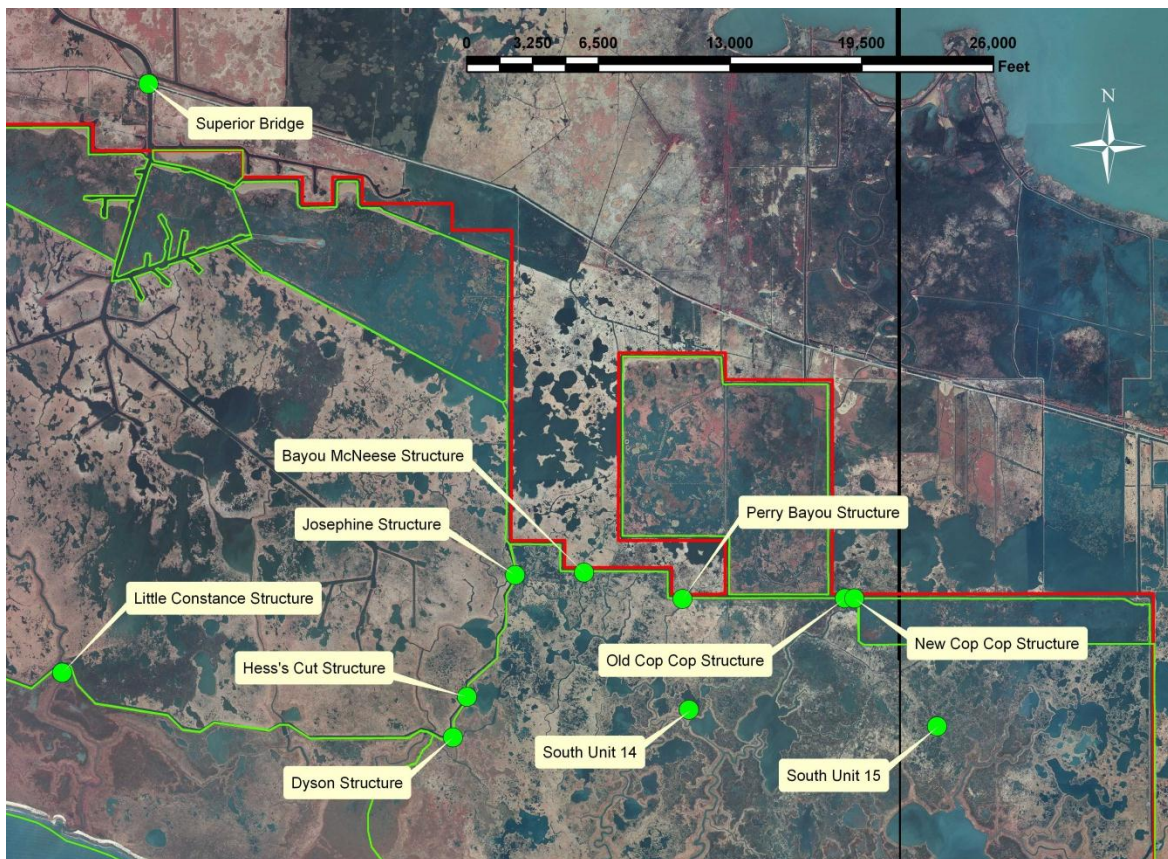
Water Control Structure	Description
Old Cop-Cop Bayou	Four-pipe stop-log flap-gate
New Cop-Cop Bayou	Four-pipe stop-log flap-gate
Perry Bayou	Three-pipe stop-log flap-gate
Bayou McNeese	Three-pipe stop-log flap-gate
Hess's Cut	Four-pipe stop-log flap-gate
Josephine	Four-pipe stop-log
Dyson Bayou	Four-pipe stop-log flap-gate
Little Constance	Three 10' X 8' stop-log flap-gate

Note: See map for structure locations.

**Table 2.**

Monitoring Stations
Superior Bridge
South of Lake 14
South of Lake 15

Note: See map for monitoring station locations



**Figure 1. Structure and Monitoring Station Locations.**

**Table 3.**

<b>Date</b>	<b>Superior Bridge Water Level (Navd 88)</b>	<b>Superior Bridge Water Salinity (PPT)</b>	<b>Structure Name</b>	<b>Hwy 82 Freshwater Introduction Project Water Control Structure Operation and Observations.</b>
10/23/2006	1.42	5.8	Old Cop-cop	Removed all stop-logs from structure to remove flood waters.
12/5/2006	0.7	3.1	Old Cop-cop	Added stop-logs in all pipes to current water level to retain water in the Mermentau Basin.
1/28/2008	0.84	1.4	Old Cop-cop	Three inches of water flowing over stop-logs.
4/7/2008	0.82	0.8	Old Cop-cop	Stop-logs were removed from two bays between January and April to increase water flow to Project Area A.
6/2/2008	1.26	0.1	Old Cop-cop	Structure is washed out and in need of repairs. Water control is compromised. Repairs scheduled for August 2008.
10/23/2006	1.42	5.8	New Cop-Cop	Removed two feet of stop-logs from structure to remove flood waters.
1/8/2007	1.42	0.8	New Cop-Cop	Removed all stop-logs from structure to remove flood waters.
1/28/2008	0.84	1.4	New Cop-Cop	Stop-logs were replaced and set at 0.5 NAVD Nov./Dec. 2007.
4/7/2008	0.82	0.8	New Cop-Cop	Stop logs were placed in structure Feb./March 2008 to retain water in the Mermentau Basin. Logs are 2" to 3" above current water level.
6/2/2008	1.26	0.1	New Cop-Cop	Removed three stop-logs from structure to increase water flow into Project Area A.
10/23/2006	1.42	5.8	Perry Bayou	Removed two feet of stop-logs from structure to remove flood waters.
1/8/2007	1.42	0.8	Perry Bayou	Removed all stop-logs from structure to remove flood waters.
1/28/2008	0.84	1.4	Perry Bayou	Stop-logs were replaced and set at 0.5 NAVD Nov./Dec. 2007.
4/7/2008	0.82	0.8	Perry Bayou	Stop logs were placed in structure Feb./March 2008 to retain water in the Mermentau Basin. Logs are 2" to 3" above current water level.
6/2/2008	1.26	0.1	Perry Bayou	Removed three stop-logs from structure to increase water flow into Project Area A.
10/23/2006	1.42	5.8	Bayou McNeese	Removed two feet of stop-logs from structure to remove flood waters.
1/8/2007	1.42	0.8	Bayou McNeese	Removed all stop-logs from structure to remove flood waters.
1/28/2008	0.84	1.4	Bayou McNeese	Stop-logs were replaced and set at 0.5 NAVD Nov./Dec. 2007.

<b>Date</b>	<b>Superior Bridge Water Level (Navd 88)</b>	<b>Superior Bridge Water Salinity (PPT)</b>	<b>Structure Name</b>	<b>Hwy 82 Freshwater Introduction Project Water Control Structure Operation and Observations.</b>
4/7/2008	0.82	0.8	Bayou McNeese	Stop logs were placed in structure Feb./March 2008 to retain water in the Mermentau Basin. Logs are 2" to 3" above current water level.
6/2/2008	1.26	0.1	Bayou McNeese	Removed three stop-logs from structure to increase water flow into Project Area A.
10/19/2006	1.42	5.8	Hess's Cut	Removed of stop-logs from structure to remove flood waters. Twenty inches of water flowing over logs.
1/3/2007	1.42	0.8	Hess's Cut	Removed all stop-logs from structure to remove flood waters.
2/21/2007	0.9	0.9	Hess's Cut	Stop logs were placed in structure Feb./March 2008 to retain water in the Mermentau Basin. Logs are 2" to 3" above current water level.
9/13/2007	1.8	0.6	Hess's Cut	Removed all stop-logs from structure to remove flood waters.
1/28/2008	0.84	1.4	Hess's Cut	Stop-logs were replaced and set at 0.5 NAVD Nov./Dec. 2007. Seven inches of water over stop-logs increasing water flow into Area A
6/3/2008	1.26	0.1	Hess's Cut	Removed three stop-logs from structure to increase water flow into Project Area A. Approximately 14" to 15" of water over stop-logs increasing water flow into Area A.
10/19/2006	1.42	5.8	Little Constance	Removed stop-logs to 3.5' below current water level to remove flood waters.
1/3/2007	1.42	0.8	Little Constance	Removed all stop-logs to remove flood water from the Mermentau Basin.
1/28/2008	0.84	1.4	Little Constance	Stop-logs are currently 10" below current water level. Stop-logs were replaced between Jan. 2007 and Jan. 2008
6/3/2008	1.26	0.1	Little Constance	Stop-logs were set 13" below current water level in west gate; 10' in center gate; and 5" in east gate. Removing excess water from the Mermentau Basin.
6/5/2008	0.96	0.7	Little Constance	All stop-logs were removed from east and center gates. Two logs were removed from west gate. The water column is approximately 3' in the east and center gates and 2' in the west gate. The flap was opened in the center gate to allow ingress and egress of estuarine organisms. The center gate will remain open until water levels or water salinities are compromised.



Date	Superior Bridge Water Level (Navd 88)	Superior Bridge Water Salinity (PPT)	Structure Name	Hwy 82 Freshwater Introduction Project Water Control Structure Operation and Observations.
10/19/2006	1.42	5.8	Josephine	Removed all but one stop-log to remove flood water from the Mermentau Basin
1/28/2008	0.84	1.4	Josephine	No action. Fifteen to 21" of water was running over stop-logs.
4/7/2008	0.82	0.8	Josephine	No action.
6/3/2008	1.26	0.1	Josephine	No action.
10/23/2006	1.42	5.8	Dyson	Removed all but one stop-log to remove flood water from the Mermentau Basin
1/3/2007	1.42	0.8	Dyson	Stop-logs were replaced sometime after 10/19/2006. Stop-logs were removed on 1/3/07. Twenty-four inches of water was running over stop-logs.
1/28/2008	0.84	1.4	Dyson	None.
4/7/2008	0.82	0.8	Dyson	None.
6/3/2008	1.26	0.1	Dyson	None.

Date	Hwy 82 Freshwater Introduction Project Water Control Structure Operation and Observations.
01/01/2009	Stop logs set at 0.80 NAVD for all structures.
05/04/2009	Removed stop logs in freshwater introduction structures.
06/09/2009	Put all stop logs back in which is set at 0.80 NAVD
10/05/2009	Removed all stop logs in freshwater introduction structures
03/18/2010	Put all stop logs in and set at 0.80 NAVD
01/26/2012	Opened all freshwater introduction structures
04/30/2012	Closed all freshwater introduction structures
07/24/2012	Opened all freshwater introduction structures

**Note: There were low water levels and higher salinity levels from July 2011 to January 2012.**